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PROGRAM DOCUMENTATION FOR THE RPV-AUTO SIMULATION PROGRAM

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The RPV-AUTO Simulation Program is a real-time, interactive, graphics simulation of a hypothetical drone control facility. Its function is to provide a means for analyzing the effects of numerous variables on the operator performance of a five-man team whose task is to control 35 Remotely Piloted Vehicles through the enroute, terminal, and return phases of a simulated strike mission.

The enroute and return phases are performed by four operators seated

at IBM 2250 Display Units. The terminal phase is simulated by a single operator who controls a remotely located terrain table using a joy stick and TV receiver. Control of the terrain table is maintained by the program through an IBM 1827 Data Control Unit.

The RPV-AUTO Simulation Program contains all of the features available in the original RPV Simulation Program previously developed by IBM personnel under this same contract. In addition, the RPV-AUTO Program contains an automatic flight plan modification ("Auto-Patch") capability and a position report (PR) smoothing capability to aid the enroute operators in performing their task.

The RPV-AUTO Simulation Program was written for an IBM System/360, Model 40 computer. Both assembler language and FORTRAN IV were used in coding the subroutines and the IBM 2250 Graphics Programming Services were utilized for the graphics software support.

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PREFACE

This program was developed for the Human Engineering Division, Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio 45433. The work was performed by International Business Machines Corporation, Gaithersburg, Maryland 20760, under Contract Number F 33 (615)-72-C-1378. Billy M. Crawford of the Systems Research Branch was the contract monitor for the Aerospace Medical Research Laboratory. The work was performed in support of Project 7184, "Human Engineering for Air Force Systems", Task 718409, "Man-Machine Systems Effectiveness".

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SECTION I

INTRODUCTION

This document, along with the program listings and card decks discussed herein, represents the total program documentation package for the RPV-AUTO Simulation Program. No attempt is made to include a total description of the RPV-AUTO Simulation. It is recommended that the user of this program familiarize himself with the total concept of the RPV-AUTO Simulation by reading the document, "Remotely Piloted Vehicle Simulation Program Instruction Manual", available through the Human Engineering Division, Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

The RPV-AUTO Simulation Program is a real-time interactive, graphics simulation of a hypothetical drone control facility (DCF). Its primary function is to provide a means for analyzing the effects of numerous variables on the operator performance of a five-man team whose task is to control up to 35 Remotely Piloted Vehicles (RPVs) through three phases of a simulated strike mission. This program contains all of the features available in the original RPV Simulation Program developed under this same contract. (Refer to HESS Report 74-2). In addition, the RPV-AUTO Simulation Program contains two new features, automatic patching ("Auto-Patch") of RPV flight plans and a position report (PR) smoothing function.

The enroute and return phases are performed by four enroute/return (ER) operators, or controllers, seated at IBM 2250 Display Units. Using a set of flight control commands, these four operators "fly" the RPVs along a preplanned flight profile to the general target area. Control is then transferred to a terminal operator who "flies" the RPV on into the target destination. The ER operator then regains control and performs the return phase.

Section II of this document contains a list of the hardware components used by the program. A brief summary of the RPV-AUTO Simulation is presented in Section III and

the program description is presented in Section IV. Section V contains the data set formats, Section VI describes the program card decks, and Section VII contains the program flowcharts. Operator instructions for the computer operator and the experimenter are presented in Appendices I and II, respectively.

SECTION II

MACHINE DEFINITION

The RPV-AUTO Simulation Program was written for an IBM System/360 Computer operating under Operating System/360 (PCP). The hardware components used by this program are listed below:

- IBM System/360 Computer, Model 40
- Problem Program Core Requirement - 201K
- Memorex 3660 Disc Storage System - Three Storage Drives
- Four IBM 2250-3 Display Units (interfaced through a 2840-2 Display Control)
- IBM 1403 Printer
- IBM 2501 Card Reader
- IBM 1052 Printer Keyborad
- IBM 1827 Data Control Unit (with digital and analog input/output features)

There are five terminal operator control panels used for the terminal phase of the simulation. Figure 1 illustrates the layout of these panels. The terrain table hardware operates independent of the CPU and is therefore not defined in this document.

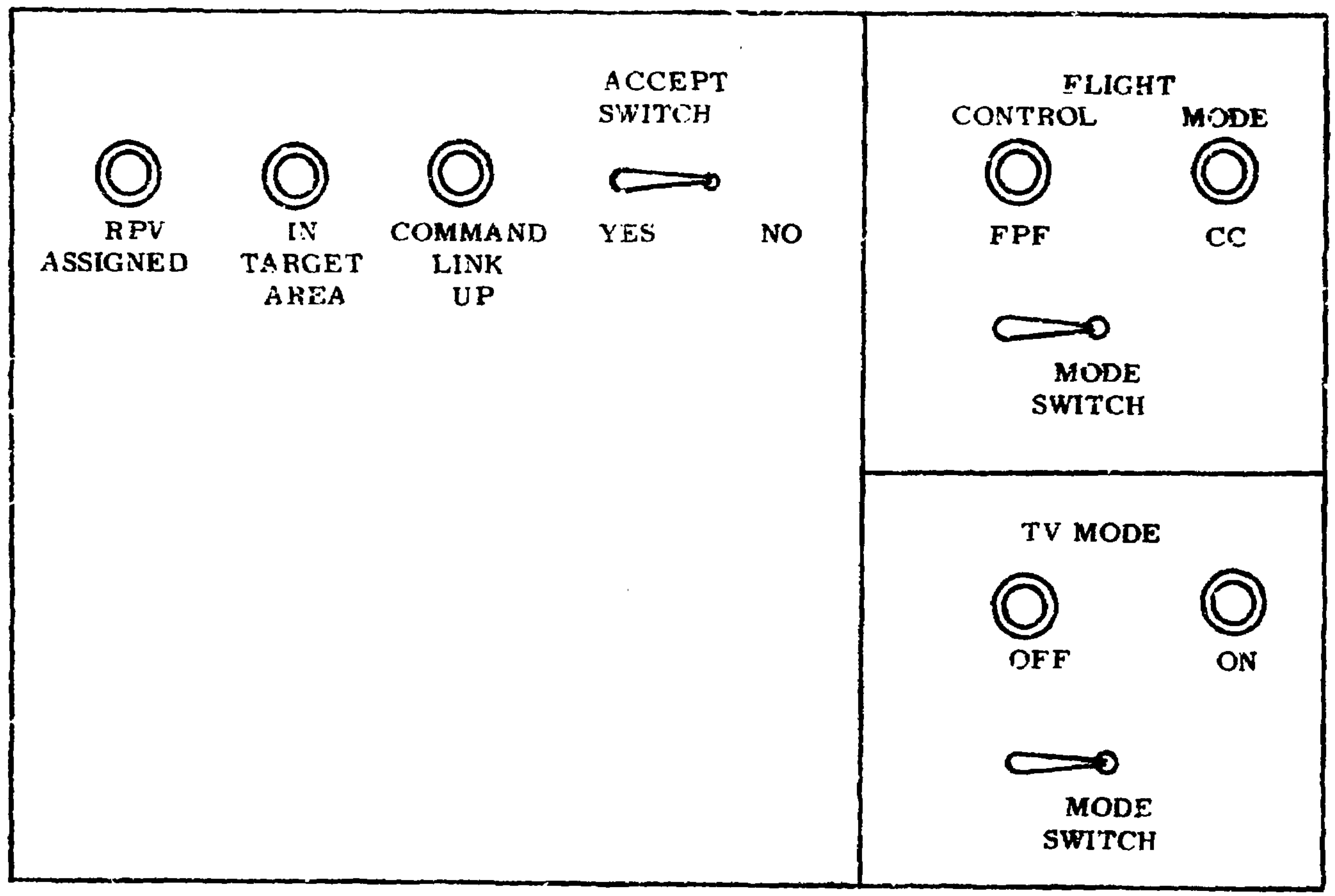


FIGURE 1. TERMINAL OPERATOR CONTROL PANEL

SECTION III

RPV-AUTO SIMULATION DESCRIPTION

This brief description of the simulation is presented here only to give the reader a better understanding of the overall program logic used in the RPV-AUTO Simulation Program. It does not represent a complete description of the simulation.

The object of the simulation is to "fly" up to 35 RPVs on the enroute, terminal, and return phases of a simulated strike mission and safely recover all the RPVs. Numerous variables, such as RPV characteristics, data link stability, navigation system errors, etc., are introduced into each mission to provide a varying degree of difficulty in performing the task.

Each team is made up of five subjects, four enroute/return (ER) operators, or controllers, and one terminal operator. The ER controllers are seated at IBM 2250 Display Units. Using a set of flight control commands, they can modify the preplanned flight plans (profiles) stored in the onboard computer of each RPV. These commands include the capability to patch the flight plan and to change the command velocity, the command altitude, and the navigation system being used. Commands are also available to cause the RPV to be destructed or dropped safely to earth with parachutes. This type of navigation, namely, flying according to the commands in the onboard computer, is referred to as flight plan follow (FPF) mode.

To assist the enroute operator in performing his task, the simulated DCF computer is equipped with an Auto-Patch capability which performs automatic patching of the flight plans when a specific set of conditions are met. A position report smoothing algorithm is also included to reduce the amount of simulated PR error generated for an RPV flying a relatively straight line path.

Figure 2 illustrates the basic display format presented to the ER controllers. The geographic area covered by the simulation is presented in the situation information display

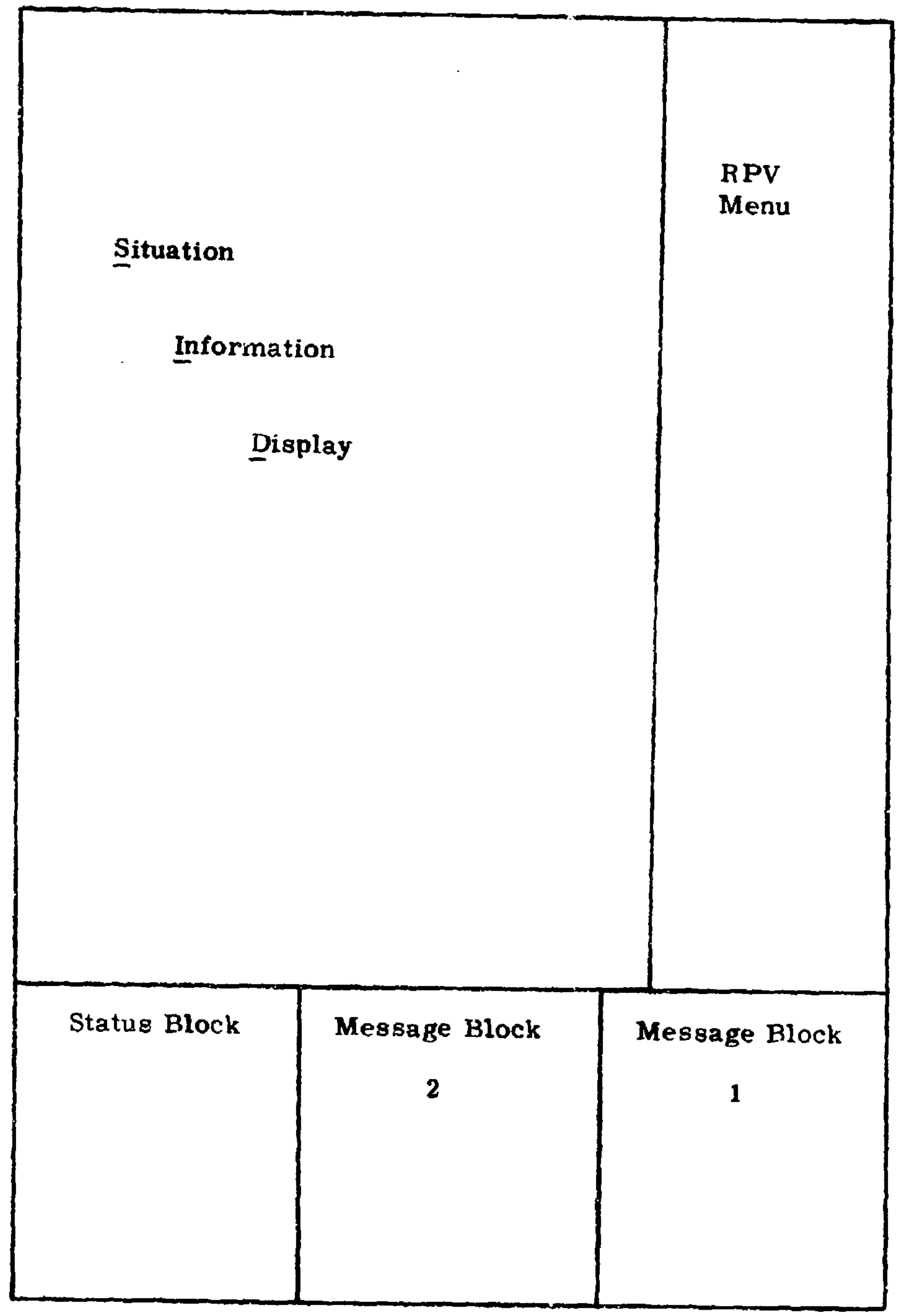


FIGURE 2. DISPLAY FORMAT

(SID) section of the screen. This display may optionally contain geographic reference markers, boundary lines, target symbols, and way point symbols. The track signatures which represent the RPV positions, and the flight plans (FPS) are category selectable and are superimposed on the geographic display. Ten FPs and/or ten track signatures can be selected at any one time. All of the information presented in the geographic display can be defined by the experimenter in the input data set. An example of an SID, with appropriate terminology, is presented in Figure 3.

The "RPV Menu" block contains one line of information for each RPV that is flying. This line contains the expected time of arrival (ETA) to the next major way point, the command link status (up or down), a suffix which identifies the next major way point, an alarm indicator, a flight control mode status indicator, and an Auto-Patch inhibit code. The menu is updated each frame to reflect the most recent information available.

The "Status Block" is used to present additional information about a specific RPV such as command altitude, command velocity, current navigation system, etc. "Message Block 2" is used to present outstanding command information; that is, to indicate those commands which have been transmitted, but not yet received by the RPV. "Message Block 1" is used to communicate with the ER operator.

As the RPVs reach the general target vicinity, control is turned over (hand over) to a terminal operator who "flys" the RPV to the target. A TV receiver is connected to a camera system on a remote terrain table model of a simulated bombing site. The terminal operator can control the RPV through joy stick and throttle controls while watching the TV monitor showing the area beneath the RPV. This control mode is referred to as continuous control (CC) mode. After the target is sited and the appropriate action is taken, control is returned (hand back) to the ER controller who then performs the return phase of the mission.

Since one terminal operator cannot handle all 35 RPVs during a mission, a pseudo-terminal phase capability

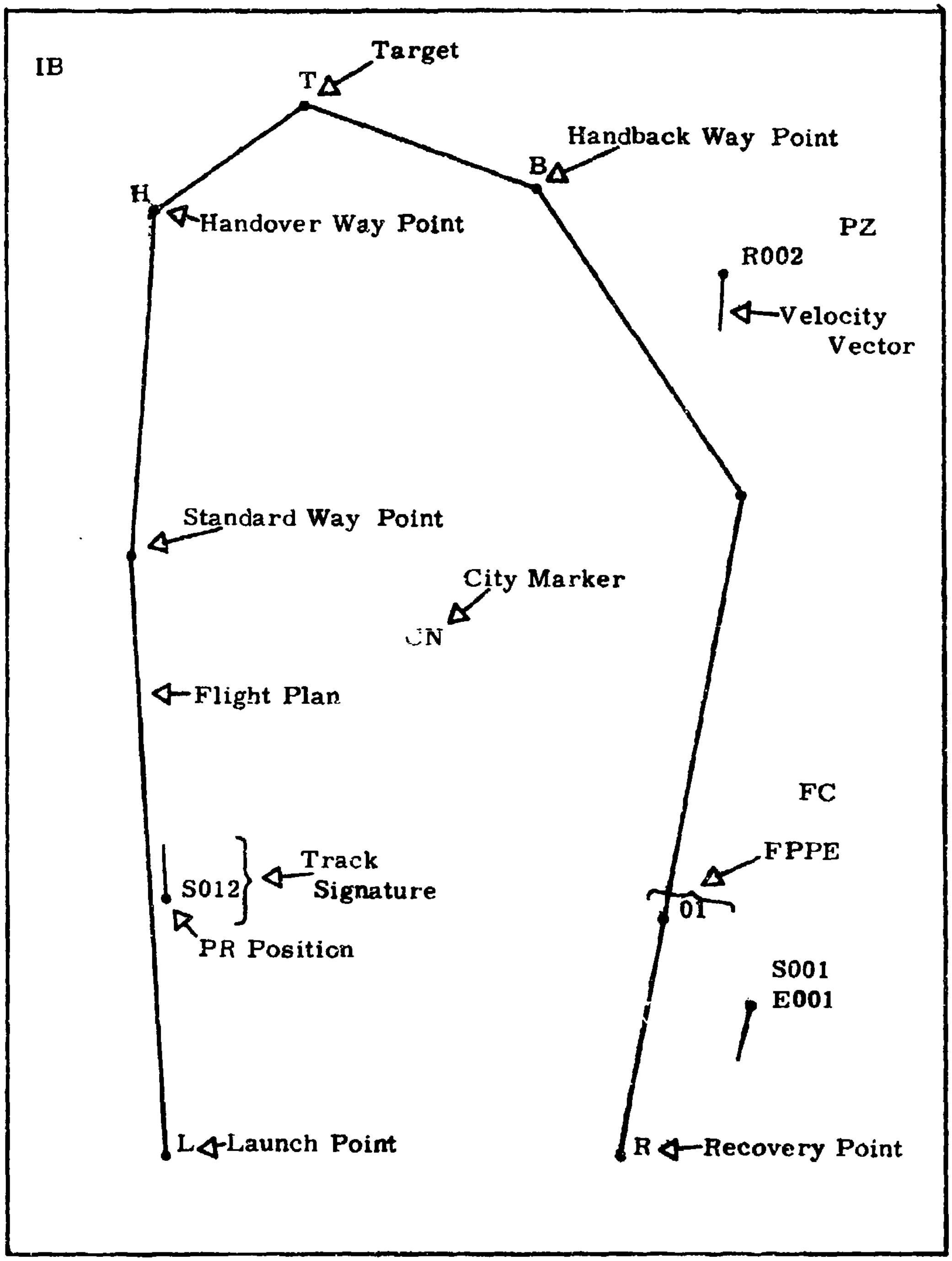


FIGURE 3. SIMULATION DISPLAY WITH LEGENDS

was added to the system. The enroute and return phases are carried out exactly as in the normal mode; however, the terminal phase consists only of the hand over switch action sequence on the selectable terminal control panels. No TV pictures are used. The flight advancement of the RPV is mathematically controlled by the program and needs no operator intervention. This is referred to as pseudo-continuous control (PCC) mode.

SECTION IV

PROGRAM DESCRIPTION

The RPV-AUTO Simulation Program consists of forty-eight user written subroutines and utilizes the macro and I/O facilities of the IBM 2250 Graphics Programming Services (GPS) for the 2250 software support. Forty-one of the subroutines are written in assembler language and the other seven are written in Fortran IV.

Table 1 lists the names of all the subroutines, the functions each performs, and the names of the subroutines which call them. Note that those subroutines listed with suffixes 1-4 (e.g. RPVA1, RPVA2, RPVA3, RPVA4) are duplications of the same subroutine except for the subroutine name and the names of the subroutines each calls. These subroutines are dedicated to scopes 1, 2, 3, and 4, respectively.

A description of the GPS facilities can be found in the manual, "IBM System/360 Operating System, Graphic Programming Services for IBM 2250 Display Unit" (File No. S360-30, Form GC27-6909).

In general, the program operates on a cyclic basis, updating the displays once per frame. The frame time is variable (currently 5 seconds) and is controlled by the CPU timer interrupt facility. Each time the timer interrupt occurs, an updated display is written to the scopes and a new display is generated for the next update. Once the new display is generated, the display generator enters a "wait" state until the timer interrupt occurs. The cycle is then repeated. Throughout this cycle, including the waiting period, attention interrupts from the four scopes are processed as they occur.

The program is contained in three parts: 1) the initialization processor, 2) the background processor, and 3) the four attention interrupt processors. The initialization processor performs all the initialization procedures at program start-up time, including generation of the initial displays. After they are written to the display units, the pro-

Subroutine Name	Function(s)	Called by:
RPVMAIN	General initialization procedures; opens all data sets; assigns 2840 buffer space; sets up initial displays.	OS/360 at program start-up time
RPVCBS	Contains the graphic attention control blocks, the graphics data control blocks, the 1827 data control blocks, the output recording data control blocks, and the GDOAs; no executable code.	Referenced through external references only
RPVRECD1	Writes all records on the output data set.	RPVMAIN, RPVCYCLE, RPVGEOA, RPVXMIT, RPVMALF, RPVTRF, RPVAP1
* RPVRECD2	Queues output records to be written by RPVRECD1 during background processing.	RPVA1-4
RPVDAT	Reads the input data set and initializes arrays constants, etc.	RPVMAIN
RPVGEOA	Generates times-one display of boundary points, geo-reference markers, and target markers.	RPVMAIN
* RPVADJST	Adjusts the 2840 transfer addresses to the buffer load point of the graphic order program.	RPVMAIN, RPVDSPY1-4

TABLE 1. SUBROUTINE FUNCTIONS

Subroutine Name	Function(s)	Called by:
RPVWRIT	Writes graphic order programs to the 2840 buffer; inserts dummy cursor; sounds audible alarm.	RPVMAIN, RPVCYCLE
RPVCYCLE	Controls the overall logic flow of the background processor; updates mission time; updates display menu; generates RPV status records; generates FPPE and PR displays. The timer control routine is also in this subroutine.	RPVMAIN
RPVUP	Mathematically updates all the RPV positions once per frame; generates navigation and PR system errors; monitors lateral deviation and fuel consumption rates.	RPVCYCLE
RPVXMIT	"Transmits" queued commands to the RPVs if proper conditions are met.	RPVCYCLE
RPVMALF	Introduces malfunctions into the system as designated on the input data set.	RPVCYCLE
* RPVS1A	Identifies an RPV from light penned coordinates.	RPVA1-4
* RPVS1B	Scales screen coordinates to grid coordinates.	RPVA1-4

TABLE 1. SUBROUTINE FUNCTIONS (Continued)

Subroutine Name	Function(s)	Called by:
* RPVS1C	Scales grid coordinates of FPPE position to raster units for screen display.	RPVCYCLE, RPVTR1-4
* RPVS1D	Scales grid coordinates to screen coordinates.	RPVCYCLE, RPVFPBG, RPVFP1-4
* RPVF2H	Converts floating point real numbers to halfword integer numbers.	RPVCYCLE, RPVFPBG, RPVFP1-4, RPVTR1-4
* RPVH2F	Converts halfword integer numbers to floating point real numbers.	RPVA1-4
RPVERR	Generates ground course and ground speed error factors for the navigation system in use.	RPVUP, RPVXMIT
RPVRFO	Statistically controls the up and down link statuses for the command, PR, and TV links.	RPVUP
RPVTRF	Controls the interface between the program and the terminal operator's control station as well as the PCC control boxes.	RPVUP
RPVBD1	Performs the coordinate transformations between the terrain table and the program.	RPVUP

TABLE 1. SUBROUTINE FUNCTIONS (Continued)

Subroutine Name	Function(s)	Called by:
RPVC1A	Tests the validity of a heading patch request. If valid and command link is up, the way points of the new patch leg are generated.	RPVXMIT
RPVFPBG	Generates a flight plan display for the background processor.	RPVXMIT
* RPVSTAT	Generates the "status block" and "message block 2" displays for the bottom of the screen.	RPVXMIT, RPVA1-4
RPVDAO	Writes digital output and analog output; reads analog input.	RPVTRF, RPVBD1
RPVASYN	Writes an error message on console typewriter if asynchronous error occurs.	Entered via interrupt processor
RPVA1-RPVA4	Processes all the interrupts, except asynchronous errors, from the four scopes: RPVA1 for scope 2E0 RPVA2 for scope 2E1, RPVA3 for scope 2E2, and RPVA4 for scope 2E3.	Entered via interrupt processor
RPVTR1-RPVTR4	Generates the PR track displays for the interrupt processor subroutines.	RPVA1-4, RPVDSPY1-4

TABLE 1. SUBROUTINE FUNCTIONS (Continued)

Subroutine Name	Function(s)	Called by:
RPVFP1-RPVFP4	Generates one or all of the flight plan displays for the interrupt processor subroutines.	RPVA1-4, RPVDSPY1-4
RPVDSPY1-RPVDSPY4	Generates the entire display (whenever a complete scale change is needed) for RPVA1, RPVA2, RPVA3, and RPVA4, respectively.	RPVA1-4
RPVDOT	Generates the xy coordinates for the dotted flight plans used for the reconnect function.	RPVDSPY1-4
* RPVCN1	Identifies the point of reconnection following a heading patch definition.	RPVA1-4
* RPVMSG	Moves a message into the "Message Block 1" section of of the GDOA.	RPVA1-4
RPVAP1	Sets up all the pointers and flags for an automatic patch.	RPVUP
RPVAP2	Determines the point of reconnect for the automatic patch function.	RPVAP1

* Subroutines are reenterable

TABLE 1. SUBROUTINE FUNCTIONS (Concluded)

gram enters a wait state until the signal is given, via a programmed function keyboard (PFK) key, to begin the simulation. Control is then given to the background processor.

The main function of the background processor is to generate the SID for each frame. This process includes the mathematical update of the RPV positions, generation of automatic patches when applicable, and the generation of the total geographic display. In addition, various flight control commands may have been queued up during the past frame. If the proper conditions are met, these commands are "transmitted" to the RPVs at this time. After these functions are performed, the background processor enters a wait state until triggered again by the timer interrupt.

The attention interrupt processors (one for each scope) process the attention requests from the ER controllers. They are processed as they occur with processing priority going to the most recent interrupt. The response to the request varies from the generation of a simple instruction to the queuing of a flight control command for subsequent transmission by the background processor. After the response is made, control is returned to the background processor or to one of the other attention processors, whichever is applicable.

Most of the data communications among the various subroutines are maintained through the COMMON CSECT. This buffer contains the four communication areas (COMAREAS) associated with the Graphic Attention Control Blocks (GACBs) for the four scopes. A DSECT (COMA) is used for addressability within each of these areas.

The four graphic data output areas (GDOAs) are also maintained in core storage throughout the simulation. The "next" situation display is generated in the GDOAs and held there until the timer interrupt occurs at which time the GDOAs are written to the graphic buffers. The GDOAs are structured as shown in Figure 4. The various GOP components are generated directly in the GDOA segment assigned to that specific component.

The following paragraphs discuss several of the

Transfer Logic
Boundary Lines
Geo-reference Markers
Targets
Status Block
Message Block 2
Message Block 1
Dotted Flight Plans
RPV Information Menu
Flight Plans
Track Signatures
Light Pen Tracking Symbol
Reserved for System Use

FIGURE 4. GOP STRUCTURE

techniques used in the program which might not be immediately obvious to the user.

A large segment of the initialization subroutine, RPVMAIN, is overlayed by the attention routine work areas. This does not interfere with normal program execution because the section overlayed is only used at program start-up time. At program termination time, control is returned to the section beyond the work areas for file closing and the return to OS/360.

A "dummy" cursor is inserted into the GDOA whenever a real cursor is not needed for entering data. This is done to prevent the subjects from accidentally locking the keyboards. Null characters are placed in the cursor location so that it is not visible on the display screen. This process is handled in the subroutine, RPVWRIT.

Output data records are queued by the attention interrupt processors to avoid interference between the attention routines and the background processor attempting to record data simultaneously. The queued records are written once each frame in the background processor subroutine, RPVCYCLE.

The timer interrupt routine is also located in the subroutine, RPVCYCLE. Its only function is to post completion for the background processor.

The RPVUP subroutine performs the mathematical updating of the four RPV positions maintained for each RPV. Two of these are kept internally for subsequent scoring purposes and the other two are displayed on the screen. The flight plan position extrapolated (FPPE) is the location on the flight plan where one would expect the RPV to be if there were no navigational errors or position reporting system errors in the system. This location is displayed on the flight plan along with the RPV ID number. It may be located on the original flight plan or on a patch leg if a heading change is made.

The "TRUE" RPV position is known only to the program and reflects the true position of the RPV. Its location

is obtained by adding navigation system errors in ground course and ground speed to the difference in the old and new FPPE positions, then adding this to the previous TRUE position. A new set of navigation system errors are obtained each time the RPV passes a roll-out way point.

The position reporting (PR) system position is represented on the display screen by the base of the velocity vector of each RPV. It is obtained by adding azimuth and range errors from the simulated PR system to the TRUE position of the RPV.

If the PR smoothing feature is used, the amount of PR error is reduced when the RPV flys down a straight line path. A special counter is used for this purpose. It is incremented once each frame and reset to zero each time the RPV passes a roll-out point during a turn maneuver. The square root of this counter is used as a reduction factor to limit the size of the standard deviation used when computing the azimuth and range errors.

The fourth position is called the virtual flight plan position extrapolated (VFPPE) and represents the location where the RPV would be located on the original flight plan based on its current expected time of arrival (ETA). This position is not displayed, but is used at data reduction time to determine how far the RPV had flown off course.

The manner in which these four positions are calculated varies somewhat depending on the current control mode of the RPV, namely, FPF, CC, or PCC. The different techniques used can be followed in the program listing of RPVUP.

In the subroutines, RPVUP and RPVERR, a selection technique is used for determining the type of distribution to be used in obtaining PR system and navigational system errors, respectively. This technique permits the user to specify a distribution code on the input data set for each system. Currently, only the Gaussian distribution is used, but others could be added in the future.

Two techniques are available for controlling the up or down status of the command, PR, and TV data links. Both techniques are performed by the RPVRFO subroutine. In the first technique, a mean-time between outage (MTBO) function is used to statistically control all three links, independent of each other. The MTBO values may be changed at input time to satisfy the needs of the user.

In the second technique, the command and PR data links are controlled through the use of a jamming model. A line of jammers is defined at a specified y-coordinate in front of and aimed at the target area. The distance between jammers and the effective beam width of the RPV antennas are also specified. Jamming triangles are thus formed with the jammers located at the apex of each triangle and the base defined by the antenna beam width. The jamming area is further devided into 25 equal segments in the y-direction in which the user may specify the probability of jamming for each segment. Whenever an RPV is inside one of the jamming triangles, a random number is generated and compared to the probability of jamming figure for the segment in which it is located. If the number is less than the probability value, the command and PR data links are set down for that frame.

When using the jamming model, the TV link is always in the up status. However, an external noise generator is used to cause varying degrees of picture distortion.

Using the program flowcharts and program listings, the user should be able to follow the rest of the logic used throughout the program. It is again recommended that the instruction manual noted in Section I be read for a thorough understanding of the simulation.

SECTION V

INPUT/OUTPUT FORMATS

There are three input data sets and one output data set in addition to the graphics and 1827 DCU data sets. Input File 1 contains the total definition of the simulation in terms of Auto-Patch controls, geographic reference data, flight plan data, target data, RPV characteristics, data link outage frequencies, probabilities of success as a function of lateral deviation, lateral deviation thresholds for alarms, fuel consumption rates, and an optional jamming model.

Figure 5 illustrates the file format for Input File 1. It is referenced by the program via the "FT09F001" DD card. Note that the Fortran format that is used in reading each variable is listed. The user is cautioned to adhere to the specified format, left-justifying A-Format data and right-justifying I-Format data. This file should be stored on disk and is generated by the RPVPATH Program available at the HESS facility.

The second input file contains malfunction data. It is generated between simulation runs by the RPVMALF Program available at the HESS facility. The format used is illustrated in Figure 6 and a list of the malfunction types is presented in Table 2. Program reference is made through DD card, "FT08F001".

The format for Input File 3 is illustrated in Figure 7. This file contains the transformation coefficients for the terrain table and is generated by the terrain table CALIBRATE Program available at the HESS facility. The data is referenced by DD card, "FT05F001". This data set is replaced whenever a new calibration run is made.

The Output Recording file format is illustrated in Figure 8. This file is referenced in the execution deck by DD card, "OUT". The formats for the various records are listed by record numbers and/or record types. The type field is a code which can be used for identifying the records at data reduction time. The list of type codes is presented in Table 3. The fields listed as "Unused" were inserted

into the records to maintain uniformity in record positions of the various fields. The "Type Constant" column may be used, where applicable, for setting up alignments in a Fortran analysis program.

Error codes and messages are listed in Table 4. The 1827 DCU addressing schemes are presented in Tables 5-8.

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
1	1	Auto-Patch Inhibit Switch 1 = Inhibit Auto-Patch, 0 = Use Auto-Patch	I1	----
	3	PR Smoothing Inhibit Switch 1 = Inhibit PR Smoothing, 0 = Use PR Smoothing	I1	----
	5-6	Number of position reports needed on straight line path before Auto-Patch will be triggered.	I2	----
	11-20	Distance between VFPPE and reconnect point for Auto-Patch function.	F10.6	.1 Mile
	21-30	Maximum reduction factor for PR smoothing algorithm.	F10.6	----

FIGURE 5. FORMAT FOR INPUT FILE 1

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
2	1-10	Lower left x-coordinate of geographic grid.	F10.2	.1 Mile
	11-20	Lower left y-coordinate of geographic grid.	F10.2	.1 Mile
	21-30	Upper right x-coordinate of geographic grid.	F10.2	.1 Mile
	31-40	Upper right y-coordinate of geographic grid.	F10.2	.1 Mile
	41-50	Distance between relay aircraft & launch site.	F10.2	.1 Mile
	51-60	Distance across grid for expanded display 1.	F10.2	.1 Mile
	61-70	Distance across grid for expanded display 2.	F10.2	.1 Mile
	74-75	Frame time.	I2	Seconds
The next set of records define geographic boundary lines. (Minimum = 2, maximum = 50)				
1	1-2	Record type = "GA".	A2	----
2-n	1-2	Record type = "GA".	A2	----
	11-20	x-coordinate of boundary point.	F10.2	.1 Mile
	21-30	y-coordinate of boundary point.	F10.2	.1 Mile
	31-32	Any character. Whenever different from char. on previous record, a new line is started.	A2	----

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
The next set of records define geo-reference markers. (Minimum = 1, maximum = 40)				
1	1-2	Record type = "LL".	A2	----
2-n	1-2	Record type = "LL".	A2	----
	11-20	x-coordinate of marker.	F10.2	.1 Mile
	21-30	y-coordinate of marker.	F10.2	.1 Mile
	31-32	Two-character marker designator.	A2	----
The next set of records define target positions. (Minimum = 1, maximum = 40)				
1	1-2	Record type = "TG".	A2	----
2-n	1-2	Record type = "TG".	A2	----
	11-20	x-coordinate of target position.	F10.2	.1 Mile
	21-30	y-coordinate of target position.	F10.2	.1 Mile
	31-32	Two-character target designator.	A2	----
The next set of records define the flight plans. There can be 1 to 35 flight plans with 2 to 50 way points each.				
1	1-2	Record type = "FP".	A2	----

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
"FP" records (cont'd)	1-2	Record type = "FP".	A2	----
	11-20	x-coordinate of way point.	F10.2	.1 Mile
2-n	21-30	y-coordinate of way point.	F10.2	.1 Mile
	31-32	ID number. Use same number for all way points on a given flight plan. Begin with "01" and use consecutive numbers.	I2	----
	33-39	Heading angle from last way point to this one. The heading angle for way point #1 = 0.	F7.3	Degrees
	41	ETA suffix to be displayed in menu.	A1	----
	42	Roll-out code. "R" = roll-out way point. blank = non-roll way point.	A1	----
	46-47	Way point designator. From 0 to 10 of the way points in each flight plan may have two-character designators displayed on the screen beside the point.	A2	----
	Repeat the (2-n) sequence for each flight plan desired.			

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
		The next set of records define the RPVs. Three records are used for each one. (Minimum # RPVs = 1, maximum = 35).		
1	1-2	Record type = "TR".	A2	----
Record 1 for each RPV	1-2	Record type = "TR".	A2	----
	4-5	RPV ID No. (Use 01 to 35).	I2	----
	7-8	Type of RPV.	A2	----
	10-15	x-coordinate of starting location.	F6.1	.1 Mile
	17-22	y-coordinate of starting location.	F6.1	.1 Mile
	24-27	Velocity at launch.	I4	Knots
	29-32	Maximum velocity permitted.	I4	Knots
	34-37	Minimum velocity permitted.	I4	Knots
	39-44	Amount of fuel at launch.	I6	Lbs.
	46-50	Altitude.	I5	Feet

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
Record 1 for each RPV (cont'd)	52-53	Primary navigation system code.	A2	----
	55-56	Secondary navigation system code.	A2	----
	58-59	Tertiary navigation system code.	A2	----
	61-63	Time at which RPV is to be launched relative to start of mission	I3	Minutes
	65-66		I2	Seconds
Record 2 for each RPV	1-7	Mean ground course (GC) error-nav. sys. #1.	F7.4	Radians
	8-14	Standard deviation.	F7.4	Radians
	15	Code for distribution to be used in obtaining error ("1" = Gaussian)	I1	----
	16-21	Mean ground speed (GS) error-nav. sys. #1.	F6.3	Knots
	22-27	Standard deviation.	F6.3	Knots
	29	Distribution code.	I1	----
	31-37	Mean GC error-nav. sys. #2.	F7.4	Radians
	38-44	Standard deviation.	F7.4	Radians
	45	Distribution code.	I1	----

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
Record 2 for each RPV (cont'd)	46-51	Mean GS error - nav. sys. #2.	F6.3	Knots
	52-57	Standard deviation.	F6.3	Knots
	59	Distribution code.	I1	----
Record 3 for each RPV	1-7	Mean GC error - nav. sys. #3.	F7.4	Radians
	8-14	Standard deviation.	F7.4	Radians
	15	Distribution code.	I1	----
	16-21	Mean GS error - nav. sys. #3.	F6.3	Knots
	22-27	Standard deviation.	F6.3	Knots
	29	Distribution code.	I1	----
	31-37	Mean azimuth error - PR system.	F7.4	Radians
	38-44	Standard deviation.	F7.4	Radians
	45	Distribution code.	I1	----
	46-51	Mean range error - PR system.	F6.3	Miles
	52-57	Standard deviation.	F6.3	Miles

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
Record 3 for each RPV (cont'd)	59	Distribution code.	I1	----
	61-63	Minimum radius of turn.	F3.1	Miles
	64-66	Target entry path index for TRF table.	I3	----
	67-73	Cosine of target entry angle.	F7.4	----
	74-80	Sine of target entry angle.	F7.4	----
The next set of records define the link outage time as a function of range from the launch site. There are 3 sets of 3 records each, the first set for the command link, the second set for the PR link, and the third set for the TV link. Note: This data must be included regardless of whether the jamming model is included on the end of this data set.				
1	1-2	Record type = "LK".	A2	----
Record 1 for each link	1-2	Record type = "LK".	A2	----
	5-10	Time that link remains up - Range = 0-9 miles.	E6.2	Seconds
	14-20	Range = 10-19 miles.	F7.2	Seconds
	24-30	Range = 20-29 miles.	F7.2	Seconds
	34-40	Range = 30-39 miles.	F7.2	Seconds

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
Record 1 for each link (cont'd)	44-50	Range = 40-49 miles.	F7.2	Seconds
	54-60	Range = 50-59 miles.	F7.2	Seconds
	64-70	Range = 60-69 miles.	F7.2	Seconds
	74-80	Range = 70-79 miles.	F7.2	Seconds
Record 2 for each link	1-2	Record type = "LK".	A2	----
	4-10	Time that link remains up - Range = 80-89 miles.	F7.2	Seconds
	14-20	Range = 90-99 miles.	F7.2	Seconds
	24-30	Range = 100-109 miles.	F7.2	Seconds
	34-40	Range = 110-119 miles.	F7.2	Seconds
	44-50	Range = 120-129 miles.	F7.2	Seconds
	54-60	Range = 130-139 miles.	F7.2	Seconds
	64-70	Range = 140-149 miles.	F7.2	Seconds
	74-80	Range = 150-159 miles.	F7.2	Seconds

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
"LK" records (cont'd)	1-2	Record type = "LK".	A2	----
	4-10	Time that link remains up - Range = 160-169 miles.	F7.2	Seconds
Record 3 for each link	14-20	Range = 170-179 miles.	F7.2	Seconds
	24-30	Range = 180-189 miles.	F7.2	Seconds
	34-40	Range = 190-199 miles.	F7.2	Seconds
	44-50	Range = 200-209 miles.	F7.2	Seconds
	54-60	Range = 210-219 miles.	F7.2	Seconds
	64-70	Range = 220-229 miles.	F7.2	Seconds
	74-80	Range = 230-∞ miles.	F7.2	Seconds

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
The next set of records define the probability of success as a function of lateral deviation. Records 2 and 3 are used to create a *two-step index into the probability of success table* created from records 4 through 11.				
1	1-2	Record type = "LD".	A2	----
2	1-2	Record type = "LD".	A2	----
	4-10	Lateral deviation header 1.	F7.3	Miles
	12-18	Lateral deviation header 2.	F7.3	Miles
	20-26	Lateral deviation header 3.	F7.3	Miles
	28-34	Lateral deviation header 4.	F7.3	Miles
	36-42	Lateral deviation header 5.	F7.3	Miles
	44-50	Lateral deviation header 6.	F7.3	Miles
	52-58	Lateral deviation header 7.	F7.3	Miles
	60-66	Lateral deviation header 8.	F7.3	Miles

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
"LD" records (cont'd)	1-2	Record type = "LD".	A2	----
	4-10	Altitude header 1.	F7.1	Feet
3	12-18	Altitude header 2.	F7.1	Feet
	20-26	Altitude header 3.	F7.1	Feet
	28-34	Altitude header 4.	F7.1	Feet
	36-42	Altitude header 5.	F7.1	Feet
	44-50	Altitude header 6.	F7.1	Feet
	52-58	Altitude header 7.	F7.1	Feet
	60-66	Altitude header 8.	F7.1	Feet
4	1-2	Record type = "LD".	A2	----
	4-10	Prob. of success per mile for: Lat. dev. header 1, altitude header 1.	F7.6	----
	12-18	Lat. dev. header 2, altitude header 1.	F7.6	----
	20-26	Lat. dev. header 3, altitude header 1.	F7.6	----
	28-34	Lat. dev. header 4, altitude header 1.	F7.6	----

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
"LD" records (cont'd) 4	36-42	Lat. dev. header 5, altitude header 1.	F7.6	----
	44-50	Lat. dev. header 6, altitude header 1.	F7.6	----
	52-58	Lat. dev. header 7, altitude header 1.	F7.6	----
	60-66	Lat. dev. header 8, altitude header 1.	F7.6	----
5	Repeat format for record 4, but use altitude header 2.			
6	Repeat format for record 4, but use altitude header 3.			
. . .	. . . .			
11	Repeat format for record 4, but use altitude header 8.			

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
The next three records define the lateral deviation alarm system as a function of altitude				
1	1-2	Record type = "LA".	A2	----
2	1-2	Record type = "LA".	A2	----
	4-10	Lateral deviation header 1.	F7.3	Miles
	12-18	Lateral deviation header 2.	F7.3	Miles
	20-26	Lateral deviation header 3.	F7.3	Miles
	28-34	Lateral deviation header 4.	F7.3	Miles
	36-42	Lateral deviation header 5.	F7.3	Miles
	44-50	Lateral deviation header 6.	F7.3	Miles
	52-58	Lateral deviation header 7.	F7.3	Miles
	60-66	Lateral deviation header 8.	F7.3	Miles
3	1-2	Record type = "LA".	A2	----
	4-10	Altitude header 1.	F7.1	Feet
	12-18	Altitude header 2.	F7.1	Feet
	20-26	Altitude header 3.	F7.1	Feet
	28-34	Altitude header 4.	F7.1	Feet

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
"LA" records (cont'd)	36-42	Altitude header 5.	F7.1	Feet
	44-50	Altitude header 6.	F7.1	Feet
3	52-58	Altitude header 7.	F7.1	Feet
	60-66	Altitude header 8.	F7.1	Feet
The next set of records define the fuel consumption rates for varying altitudes at three different velocities.				
1	1-2	Record type = "FU".	A2	----
2	1-2	Record type = "FU".	A2	----
	4-9	Fuel rate at altitude = 0, velocity = 300.	F6.2	Lbs
	11-16	Fuel rate at altitude = 1000, velocity = 300.	F6.2	Lbs
	18-23	Fuel rate at altitude = 2000, velocity = 300.	F6.2	Lbs
	25-30	Fuel rate at altitude = 3000, velocity = 300.	F6.2	Lbs
	32-37	Fuel rate at altitude = 4000, velocity = 300.	F6.2	Lbs
	39-44	Fuel rate at altitude = 5000, velocity = 300.	F6.2	Lbs
	46-51	Fuel rate at altitude = 6000, velocity = 300.	F6.2	Lbs

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
"FU" records (cont'd) 2	53-58	Fuel rate at altitude = 7000, velocity = 300.	F6.2	Lbs
	60-65	Fuel rate at altitude = 8000, velocity = 300.	F6.2	Lbs
	67-72	Fuel rate at altitude = 9000, velocity = 300.	F6.2	Lbs
	74-79	Fuel rate at altitude = 10,000, velocity = 300.	F6.2	Lbs
3	Same format as record 2, but velocity = 400.			
4	Same format as record 2, but velocity = 500.			
The next set of records are <u>optional</u> and represent a jamming model to be used for controlling the command and PR link outages. If this data is omitted, the link outages are controlled by the mean time between outage function defined by the "LK" records above. Note: If the jamming model is not to be used, <u>do not</u> include any of the following records.				
1	1-2	Record type = "JM".	A2	----
2	1-2	Record type = "JM".	A2	----

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
"JM" records (cont'd)	11-20	y-coordinate where jammers are located.	F10.2	.1 Mile
	21-30	Distance between jammers.	F10.2	.1 Mile
2	31-40	Effective beam width of RPV antennas.	F10.5	Radians
The distance between the jammers' y-coordinate and the maximum y-coordinate used for the geographic area covered by the simulation is divided into 25 equal segments in the y-direction. The following variables represent the probability that the links will be jammed inside each of these segments.				
3	1-8	Probability of jamming in: Segment 1	F8.6	----
	9-16	Segment 2	F8.6	----
	17-24	Segment 3	F8.6	----
	25-32	Segment 4	F8.6	----
	33-40	Segment 5	F8.6	----
	41-48	Segment 6	F8.6	----

FIGURE 5. FORMAT FOR INPUT FILE 1 (Continued)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
"JM" records (cont'd)	49-56	Segment 7	F8.6	----
	57-64	Segment 8	F8.6	----
	65-72	Segment 9	F8.6	----
	73-80	Segment 10	F8.6	----
4		Repeat Record 3 format for segments 11-20.		
5		Repeat Record 3 format (through record position 40) for segments 21-25.		

Record Format = Fixed Blocked
Logical Record Length = 80
Block Size = 800
Medium Used = Disk

NOTE: Make sure all I-Format data is right-justified and A-format data is left-justified.

FIGURE 5. FORMAT FOR INPUT FILE 1 (Concluded)

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
Malfunction Input File	1-2	Record type = "AL".	A2	----
	4-5	RPV ID number.	I2	----
(Maximum of 10 Records Permitted)	7-9	Time of malfunction occurrence (from start of mission)	I3	Minutes
	11-12		I2	Seconds
	14-15	Type of malfunction (refer to Table 2).	A2	----
	17-22	For nav. sys. malfunction, GC error.	F6.3	Radians
	24-29	For nav. sys. malfunction, GS error.	F6.3	Knots
	17-22	For PR sys. malfunction, azimuth error.	F6.3	Radians
	24-29	For PR sys. malfunction, range error.	F6.3	Miles

Record Format = Fixed

Block Size = 80

Medium Used = Disk

NOTE: Make sure all I-Format data is right-justified and A-Format data is left-justified.

FIGURE 6. FORMAT FOR INPUT FILE 2

Type	Code*
Pitch	P
Roll	R
Altitude	A
Generator	G
Thrust	T
Attrition	K
Navigation System #1	H1
Navigation System #2	H2
Navigation System #3	H3
PR System	PE
On-board Computer	C
TV Link	LT
Command Link	LC
PR Link	LP

*This code is placed in positions 14-15 of the "AL" malfunction records defined in Figure 6.

TABLE 2. MALFUNCTION TYPES

Record Number(s)	Record Position(s)	Contents	Fortran Format	Units
The final set of input records define the transformation equation coefficients for the TRF Table.				
1	1-10	Analog-to-digital equation coefficients for pitch.	E10.4	----
	11-20	"	E10.4	----
	21-30	"	E10.4	----
	31-40	"	E10.4	----
2	1-10	Digital-to-analog equation coefficients for pitch.	E10.4	----
	11-20	"	E10.4	----
	21-30	"	E10.4	----
	31-40	"	E10.4	----
The format for records 1 and 2 are repeated five times to include the coefficients for roll, yaw, radius, altitude, and theta, respectively.				

Record Format = Fixed

Logical Record Size = 80

Medium Used = Card Reader or Disk

NOTE: This data is obtained from the terrain table CALIBRATE Program.

FIGURE 7. FORMAT FOR INPUT FILE 3

Record No. or Type	Record Position(s)	Contents	Type of Constant	Units
Record 1, Type 0	1-4	Variable length control word.	----	----
	5-8	Unused.	----	----
	9-10	Record type.	Integer*2	----
	11-12	Unused.	----	----
	13-24	Experiment ID no. (yydddhhmmbbb- y=year, d=day, h=hour, m=minute).	Literal	----
Record 2, Type 30	1-4	Variable length control word.	----	----
	5-8	Unused.	----	----
	9-10	Record type.	Integer*2	----
	11-12	Unused.	----	----
	13-16	Analog-to-digital coefficients for pitch.	Real	Degrees
	17-20	"	Real	Degrees
	21-24	"	Real	Degrees
	25-28	"	Real	Degrees
	29-32	Analog-to-digital coefficients for roll.	Real	Degrees

FIGURE 8. FORMAT FOR THE OUTPUT RECORDING FILE

Record No. or Type	Record Position(s)	Contents	Type of Constant	Units
Record 2, Type 30 (cont'd)	33-36	Analog-to-digital coefficients for roll.	Real	Degrees
	37-40	"	Real	Degrees
	41-44	"	Real	Degrees
	45-48	Analog-to-digital coefficients for yaw.	Real	Degrees
	49-52	"	Real	Degrees
	53-56	"	Real	Degrees
	57-60	"	Real	Degrees
	61-64	Analog-to-digital coefficients for radius.	Real	Inches
	65-68	"	Real	Inches
	69-72	"	Real	Inches
	73-76	"	Real	Inches
	77-80	Analog-to-digital coefficients for altitude.	Real	Inches
	81-84	"	Real	Inches
	85-88	"	Real	Inches
	89-92	"	Real	Inches

FIGURE 8. FORMAT FOR THE OUTPUT RECORDING FILE (Continued)

Record No. or Type	Record Position(s)	Contents	Type of Constant	Units
Record 2, Type 30 (cont'd)	93-96	Analog-to-digital coefficients for theta.	Real	Degrees
	97-100	"	Real	Degrees
	101-104	"	Real	Degrees
	105-108	"	Real	Degrees
Record 3, Type 30	1-108	The format for record 2 is repeated. The variables contain the digital-to-analog coefficients for pitch, roll, yaw, radius, altitude, and theta, respectively.	----	----
Record 4, Type 31	1-4	Variable length control word.	----	----
	5-8	Unused.	----	----
	9-10	Record type = 31.	Integer*2	----
	11-12	Unused.	----	----
	13-14	Target index for RPV 1.	Integer*2	----
	15-16	Target index for RPV 2.	Integer*2	----

FIGURE 8. FORMAT FOR THE OUTPUT RECORDING FILE (Continued)

Record No. Type	Record Position(s)	Contents	Type of Constant	Units
Record 4, Type 31 (cont'd)	. . .	. . .	. . .	. . .
	81-82	Target index for RPV 35.	Integer*2	----
The remaining records are in no specific sequence and will therefore be listed by type only.				
Type 1	1-4	Variable length control word.	----	----
	5-6	RPV ID no.	Integer*2	----
	7-8	Unused.	----	----
	9-10	Record type = 1.	Integer*2	----
	11-12	Mission time.	Integer*2	Seconds
	13-14	ETA to next major way point.	Integer*2	Seconds
	15-16	ETA suffix (byte 16 = zeroes).	Literal	----
	17-20	True x-coordinate.	Real	.1 Mile
	21-24	True y-coordinate.	Real	.1 Mile

FIGURE 8. FORMAT FOR THE OUTPUT RECORDING FILE (Continued)

Record No. or Type	Record Position(s)	Contents	Type of Constant	Units
Type 1 (cont'd)	25-28	VFPPE x-coordinate.	Real	.1 Mile
	29-32	VFPPE y-coordinate.	Real	.1 Mile
	33-36	Altitude.	Integer	Feet
	37-40	Velocity.	Integer	Knots
	41-44	Fuel remaining.	Integer	Lbs.
	45-46	Control status.	Literal	----
	47-48	Command link status (1 = up, 0 = down).	Integer*2	----
	49-50	PR link status (1 = up, 0 = down).	Integer*2	----
	51-52	TV link status (1 = up, 0 = down).	Integer*2	----
	53-54	Current navigation system.	Literal	----
	55-56	Flight plan way point index for VFPPE.	Integer*2	----
	57-60	VFPPE in distance beyond way pt. above.	Real	.1 Mile
	61-62	PR smoothing counter.	Integer*2	----
	63-64	Auto-Patch inhibit code.	Integer*2	----

FIGURE 8. FORMAT FOR THE OUTPUT RECORDING FILE (Continued)

Record No. or Type	Record Position(s)	Contents	Type of Constant	Units
Types 2-8, 21-27, 29	1-4	Variable length control word.	----	----
	5-6	RPV ID number.	Integer*2	----
	7-8	2250 Display Unit ID number (1, 2, 3, or 4). If this number = 5, it is initiate Auto-Patch type.	Integer*2	----
	9-10	Record type.	Integer*2	----
	11-12	Mission time.	Integer*2	Seconds
	13-14	Unused.	----	----
Type 9	1-4	Variable length control word.	----	----
	5-6	RPV ID number.	Integer*2	----
	7-8	2250 Display Unit ID number (1, 2, 3, or 4).	Integer*2	----
	9-10	Record type.	Integer*2	----
	11-12	Mission time.	Integer*2	Seconds
	13-14	Terminal operator ID (0, 1, 2, 3, or 4).	Literal	----
Type 10 & 28	1-4	Variable length control word.	----	----
	5-6	RPV ID number.	Integer*2	----
	7-8	Unused.	----	----

FIGURE 8. FORMAT FOR THE OUTPUT RECORDING FILE (Continued)

Record No. or Type	Record Position(s)	Contents	Type of Constant	Units
Type 10 & 28 (cont'd)	9-10	Record type.	Integer*2	----
	11-12	Mission time.	Integer*2	Seconds
	13-14	Terminal operator ID (0, 1, 2, 3, or 4).	Literal	----
Types 11 & 13	1-4	Variable length control word.	----	----
	5-6	RPV ID number.	Integer*2	----
	7-8	Unused.	----	----
	9-10	Record type.	Integer*2	----
	11-12	Mission time.	Integer*2	Seconds
	13-14	Type of malfunction.	Literal	----
Type 12	1-4	Variable length control word.	----	----
	5-6	RPV ID number.	Integer*2	----
	7-8	Unused.	----	----
	9-10	Record type.	Integer*2	----
	11-12	Mission time.	Integer*2	Seconds
	13-14	Analog input for pitch.	Integer*2	1827 Voltages
	15-16	Analog input for roll.	Integer*2	1827 Voltages

FIGURE 8. FORMAT FOR THE OUTPUT RECORDING FILE (Continued)

Record No. or Type	Record Position(s)	Contents	Type of Constant	Units
Type 12 (cont'd)	17-18	Analog input for yaw.	Integer*2	1827 Voltages
	19-20	Analog input for radius.	Integer*2	1827 Voltages
	21-22	Analog input for altitude.	Integer*2	1827 Voltages
	23-24	Analog input for theta.	Integer*2	1827 Voltages
Type 14-20	1-4	Variable length control word.	----	----
	5-6	RPV ID number.	Integer*2	----
	7-8	Unused.	----	----
	9-10	Record type.	Integer*2	----
	11-12	Mission time.	Integer*2	Seconds

Record Format = VSB

Maximum logical record length = 108

Maximum block size = 3568

FIGURE 8. FORMAT FOR THE OUTPUT RECORDING FILE (Concluded)

Type Code	Contents or Meaning	Subroutine(s) Where Generated
0	Experiment identification number	RPVMAIN
1	RPV status information	RPVCYCLE
2	Heading patch requested by enroute operator or Auto-Patch	RPVA1-4, RPVAP1
3	Altitude change requested by enroute operator	RPVA1-4
4	Velocity change requested by enroute operator	RPVA1-4
5	Navigation system change requested by enroute operator	RPVA1-4
6	Destruct command requested by enroute operator	RPVA1-4
7	Deploy chutes requested by enroute operator	RPVA1-4
8	Drop track signature requested by enroute operator	RPVA1-4
9	Enter pending mode requested by enroute operator	RPVA1-4
10	Pending mode request accepted by terminal operator	RPVTRF
11	Malfunction occurred	RPVMALF
12	Trigger closed at TRF control station	RPVTRF
13	Attrition caused crash of RPV	RPVMALF
14	Heading patch command transmitted	RPVXMIT
15	Altitude command transmitted	RPVXMIT
16	Velocity command transmitted	RPVXMIT
17	Navigation system change command transmitted	RPVXMIT
18	Destruct command transmitted	RPVXMIT
19	Deploy chutes command transmitted	RPVXMIT
20	Heading patch rejected	RPVXMIT
21	Heading patch command cancelled by enroute operator	RPVA1-4
22	Altitude change command cancelled by enroute operator	RPVA1-4
23	Velocity change command cancelled by enroute operator	RPVA1-4

TABLE 2. OUTPUT RECORD TYPES

Type Code	Contents or Meaning	Subroutine(s) Where Generated
24	Nav. system change command cancelled by enroute operator	RPVA1-4
25	Destruct command cancelled by enroute operator	RPVA1-4
26	Deploy chutes command cancelled by enroute operator	RPVA1-4
27	Pending handover mode cancelled by enroute operator	RPVA1-4
28	Accept switch turned off at terminal operator control panel	RPVTRF
29	Reprogrammed heading patch request by enroute operator	RPVA1-4
30	TRF table transformation coefficients	RPVGEOA
31	Target identification numbers	RPVGEOA

TABLE 3. OUTPUT RECORD TYPES (Concluded)

Console Code	Message or Meaning	Correction Procedure(s)
U999	GDOA limits exceeded. Too much input data for display.	Reduce amount of input data. Check limits of each type permitted in Figures 5, 6, and 7.
U4095	I/O error on 1827 DCU.	Check 1827 patch board; rerun the job. If error persists, contact systems personnel.
----	"Asynchronous error on scope 2E0, 1, 2, or 3".	If this appears frequently contact system personnel; otherwise, ignore.

TABLE 4. ERROR CODES

Group Number	Point Number	TRF Table Interface
0	00	Pitch
	01	Roll
	02	Yaw
	03	Radius
	04	Altitude
	05	Table Position

TABLE 5. ANALOG INPUT ADDRESSING

DAC Number	Decimal Address	TRF Table Interface
1	00	Pitch
	01	Roll
2	02	Yaw
	03	Radius
3	04	Altitude
	05	Table Position

TABLE 6. ANALOG OUTPUT ADDRESSING

Decimal Address	Point Number(s)	Terminal Control Panel No.	Use or Meaning
66	0	0	Accept Switch (1 = yes, 0 = no)
	1	0	Control Mode Switch (1 = CC, 0 = FPF)
	2	0	TV Mode Switch (1 = on, 0 = off)
	3	1	Accept Switch (see above)
	4	1	Control Mode Switch
	5	1	TV Mode Switch
	6	2	Accept Switch
	7	2	Control Mode Switch
	8	2	TV Mode Switch
	9	3	Accept Switch
	10	3	Control Mode Switch
	11	3	TV Mode Switch
	12	4	Accept Switch
	13	4	Control Mode Switch
	14	4	TV Mode Switch
	15	-	Trigger Switch (1 = data in hold circuit)

TABLE 7. DIGITAL INPUT ADDRESSING

Decimal Address	Point Number(s)	Terminal Control Panel No.	Use or Meaning
119	0	0	"RPV ASSIGNED" lamp
119	1	0	"IN TARGET AREA" lamp
119	2	0	"COMMAND LINK UP" lamp
119	3	0	"FPF MODE" lamp
119	4	0	"CC MODE" lamp
119	5	0	"TV ON" lamp
119	6	0	"TV OFF" lamp
119	7-13	1	Repeat above lamp assignments
123	0-6	2	Repeat above lamp assignments
123	7-13	3	Repeat above lamp assignments
124	0-6	4	Repeat above lamp assignments
124	10	-	Release sample & hold circuit (release = 1)
120	0	-	Table control mode (1 = FPF, 0 = CC)
120	1	-	Reset table position (always = 1)
120	2	-	TV receiver switch (1 = off, 0 = on)
120	3	-	Reset trigger switch (Reset = 1)
120	4	-	Meter control switch (1 = off, 0 = on)

TABLE 8. DIGITAL OUTPUT ADDRESSING

SECTION VI

PROGRAM CARD DECKS

Source program card decks and program object decks for the RPV-AUTO Simulation Program are available at the Systems Research Branch, Human Engineering Division of AMRL. A set of printed listings of the source code is also available, both in card image format and in assembled format. This data is stored on magnetic tape, AMRL serial number 000409. File 5 contains the program object decks, with JCL for link-editing the RPV subroutines. File 6 contains the source code, with JCL, for assembling the entire set of RPV subroutines. Both files are in card image format, fixed length 80-byte records, 3200 bytes per block.

Figure 9 lists the control cards for link-editing the RPV-AUTO Simulation Program onto disk and Figure 10 lists the program execution deck. The data set name on the "FT09F001" and "OUT" DD cards must be properly specified for each run.

```
//LINKRPVA    JOB     (H' S?26,K0),AMKL,MSGLEVEL=
//STEP1       EXEC    PGM=IEWL,PARM=(LIST,MAP,OVLY)
//SYSLIB      DD      DSN=SYS1.LINKLIB,DISP=SHR
//SYSLMOD     DD      DSN=RPV.EXEC(RPVEXECA),DISP= LD
//SYSUT1      DD      UNIT=SYS A,SPACE=( 24,(  ,2 ))
//SYSPRINT    DD      SYSOUT=A
//SYSLIN      DD      DDNAME=SYSIN
//MY2         DD      DSN=SYS1.LINKLIB,DISP=SHR
//MY3         DD      DSN=SYS1.FORTLIB,DISP=SHR
//MY4         DD      DSN=SYS1.SSPLIB,DISP=SHR
//SYSIN       DD      *

     - PLACE ALL OBJECT DECKS HERE -

  INSERT   RPVMAIN,RPVCRS,RPVRECO ,RPVRECO2,RPVA JST, PVCYCLE
  INCLUDE  MY2(IFFPPAPR,IFFPKADG,I FPAAST)
  INCLUDE  MY3(IHCSSQRT,IHCUOPT,IHCEXECH,IHC RM,IHCS TN )
  INCLUDE  MY3(IHCFCVTH,IHCSL G,IHCFENTH,IHCS SCN,IHCSSCN,IHC ATBL)
  OVERLAY  ONE
  INSERT   RPVDAT,RPVGE A
  INCLUDE  MY2(IFFPLAPE)
  INCLUDE  MY3(IHCFCOMH,IHCFIOS)
  OVERLAY  ONE
  INSERT   RPVWRIT,RPVUP, PVASYN,RPVXMIT,RPVA ,RPVA ,RPVA
  INSERT   RPVA4,RPVDSPY ,RPVDSPY ,RPVDSPY3,RPVDSPY4,RPVT
  INSERT   RPVTR2,RPVTR ,RPVTR4,RPVEP ,RPVEP2,RPVEP3,RPVE
  INSERT   RPVEPHG,RPVDET,RPVS A, PVCN ,RPVAP ,RPVAP
  INSERT   RPVE2H,RPVHIF,RPVERR,RPVMALF,RPVE ,RPVMSG,RPVSTAT
  INSERT   RPVS A,RPVS B,RPVS C,RPVS  ,RPVTRF, PV A ,RPV
  INCLUDE  MY4(GAUSS,RAN U)
/*
//
```

FIGURE 9. LINK EDIT CARD DECK

```
//RPVEXEC     JOB     (HFS325,K3),  MRL,MSGLEVEL=[illegible]
//STEP1       EXEC    PGM=RPVEXECA
//STEPLIB     DD      DSN=RPV.EXEC,DISP=OLD
//DD01        DD      UNIT=2[illegible]0
//DD02        DD      UNIT=2[illegible]
//DD03        DD      UNIT=2[illegible]2
//DD04        DD      UNIT=2[illegible]3
//DDAN        DD      UNIT=[illegible]2
//DDIN        DD      UNIT=004
//DDOUT       DD      UNIT=005
//FT06F001    DD      SYSOUT=A
//DIF         DD       DSN=RPV.OUTPUT ,VOL=S[illegible]RPV[illegible] ,UNIT=[illegible] ,
//                  DISP=(,KEEP),SPAC =(CYL,([illegible],[illegible]))
//FT[illegible]9F[illegible]    DD      DSN=RRPV[illegible] ,VOL=SER=RPV[illegible] ,UNIT=SYS[illegible],DISP=OL[illegible]
//FT[illegible]8F[illegible]    DD      DSN=RPV.MALE,DISP=OL[illegible]
//FT[illegible]6F[illegible]    DD       DSN=RPV.CALB,DISP=OLD
//SYSABEND    DD      SYSOUT=A
/*
//
```

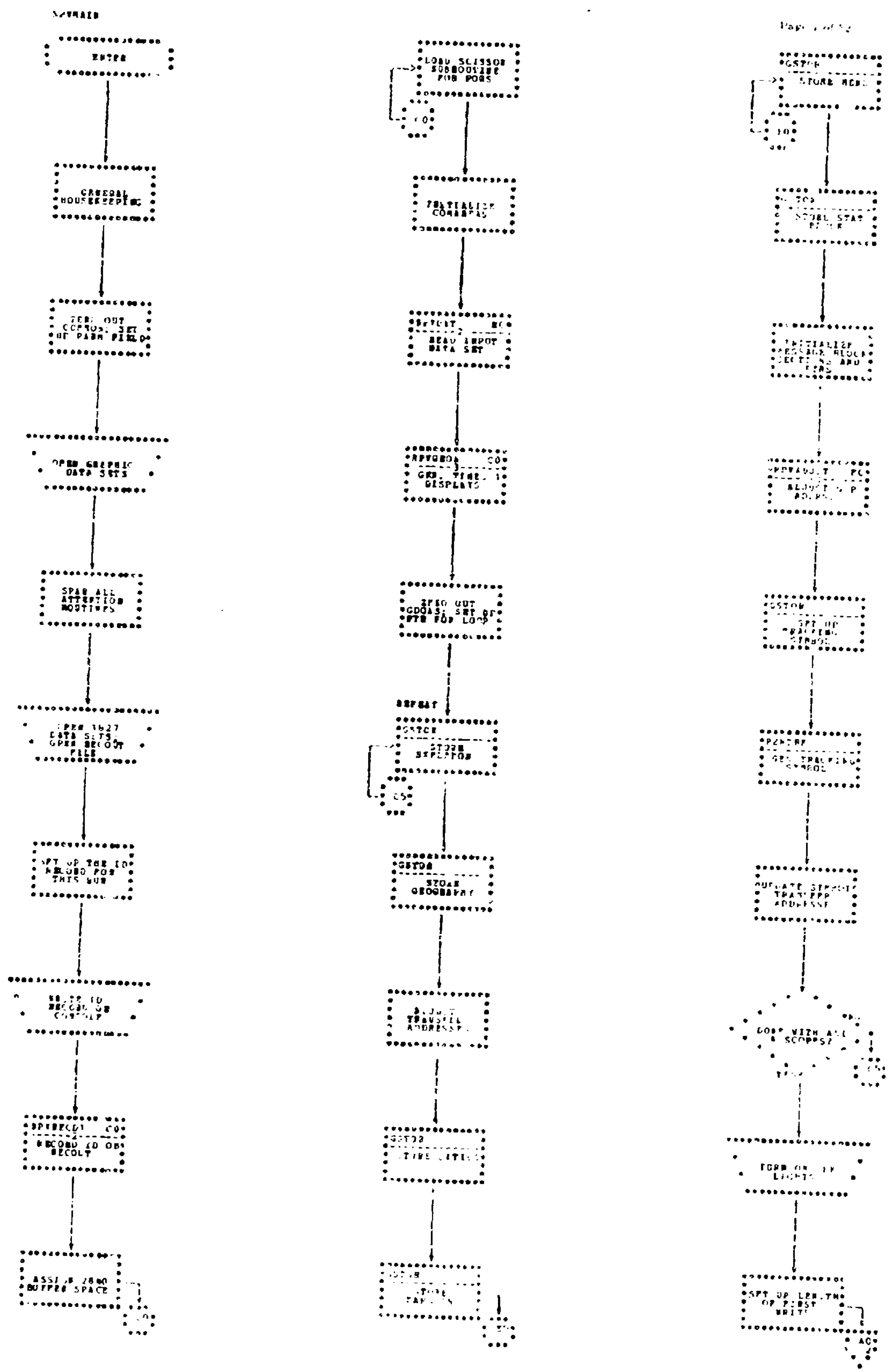
FIGURE 9. EXECUTION CARD DECK

SECTION VII

PROGRAM FLOWCHARTS

The program flowcharts are presented in Figure 11. These machine-produced flowcharts were generated by AUTODOC-V, a S/360 program. The conventions used on these flowcharts are described in "AUTODOC-V an Automatic Documentation and Symbolic Flow Charting Program", 360D-001.1.014, available at the Systems Research Branch, Human Engineering Division of AMRL.

The user should note that subroutine call blocks which contain no page reference information represents GPS subroutines that are not flowcharted in this document.



ENTER
GENERAL HOUSEKEEPING
OPEN GRAPHIC DATA SETS
SET UP THE ID RECORD FOR THIS RUN
ASSIGN 2680 BUFFER SPACE
LOAD SCISSOR SUBROUTINE FOR PORS
READ INPUT DATA SET
REPEAT
STORE GEOGRAPHY
DONE WITH ALL SCOPES?

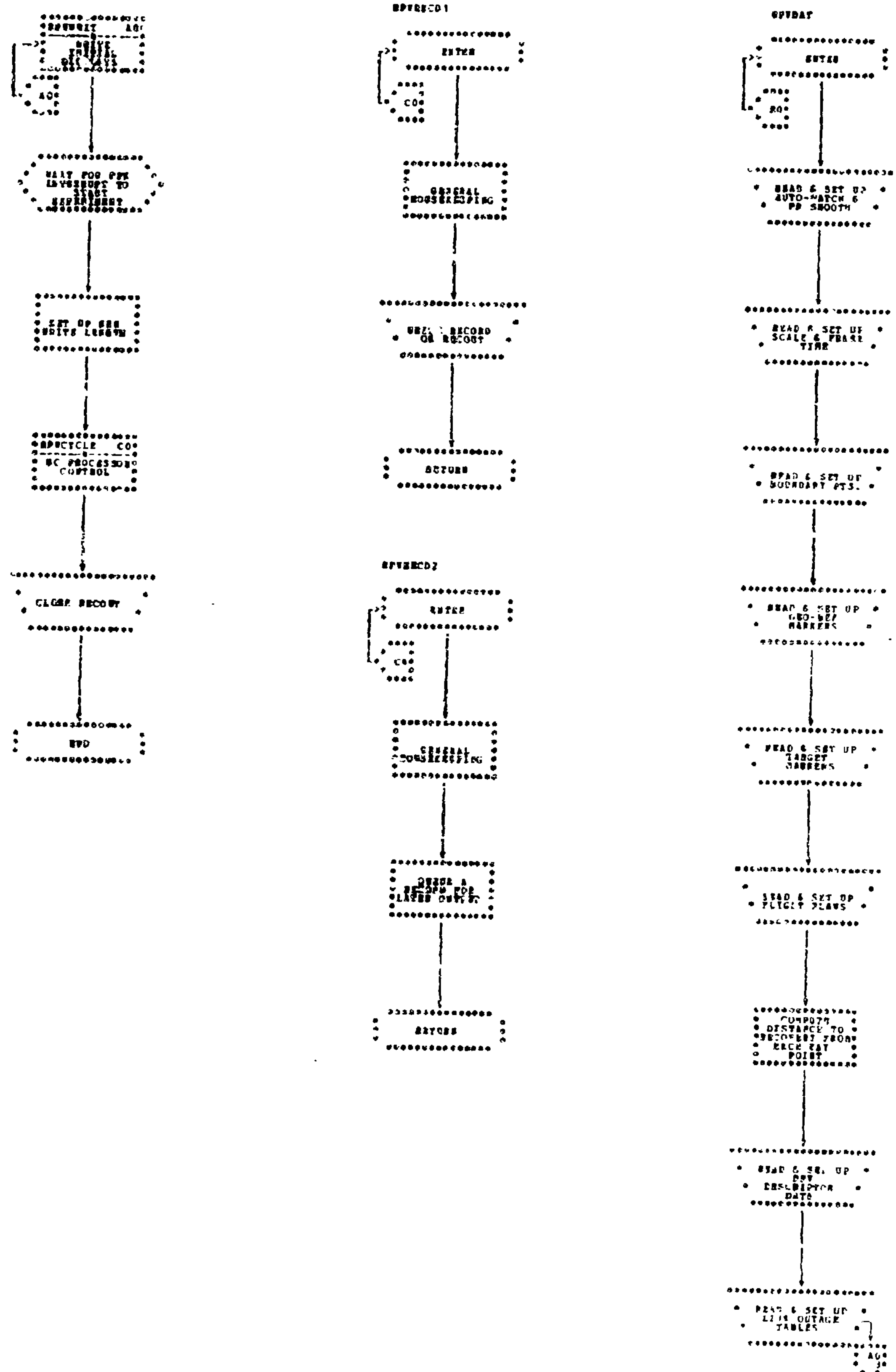
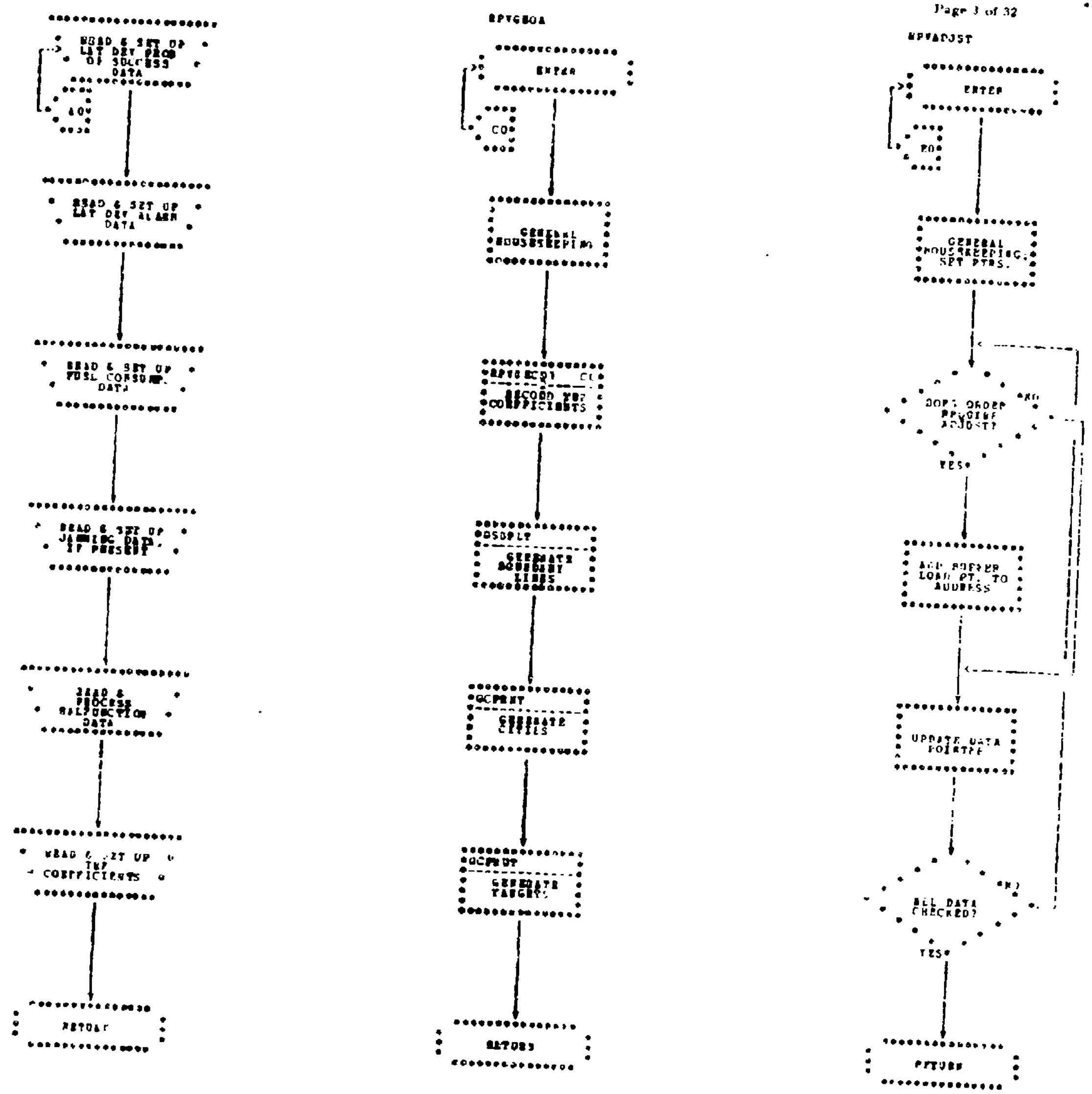


FIGURE 11 PROGRAM FLOWCHART (Continued)


READ & SET UP LAT DEV PROB OF SUCCESS DATA
READ & SET UP LAT DEV ALARM DATA
READ & SET UP FUEL CONSUMP. DATA
READ & SET UP JAMMING DATA, IF PRESENT
READ & PROCESS MALFUNCTION DATA
READ & SET UP THE COEFFICIENTS
RETURN
RPYGBOA
ENTER
GENERAL HOUSEKEEPING
RECORD RBT COEFFICIENTS
DSDPLT
GENERATE BOUNDARY LINES
GCPRNT
GENERATE CITIES
GCPROT
GENERATE TARGETS
RETURN
RPYADJST
ENTER
GENERAL HOUSEKEEPING, SET PTRS.
YES
NO
ALL DATA CHECKED?
UPDATE DATA POINTER
RETURN

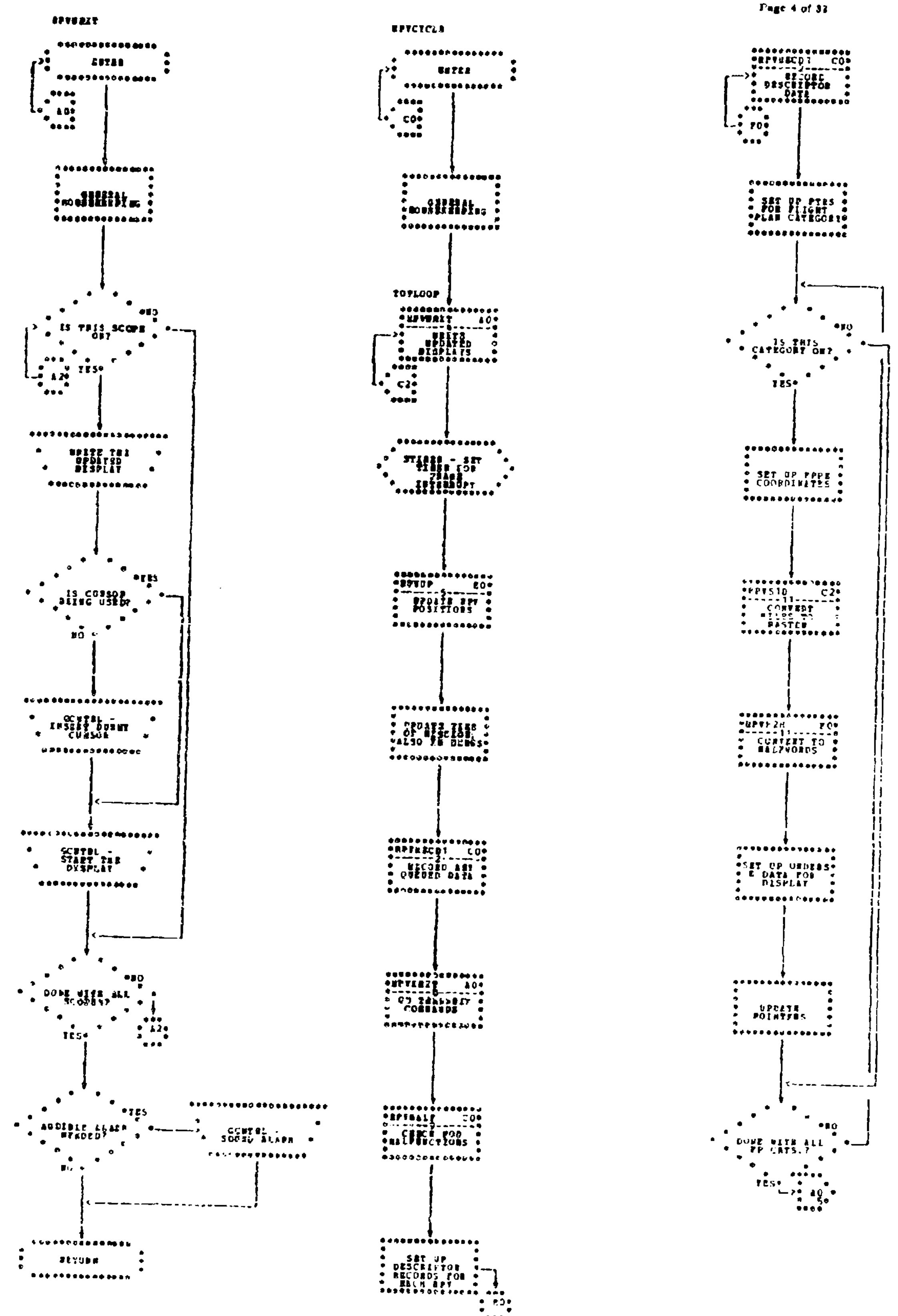


FIGURE 11. PROGRAM FLOWCHARTS (Continued)

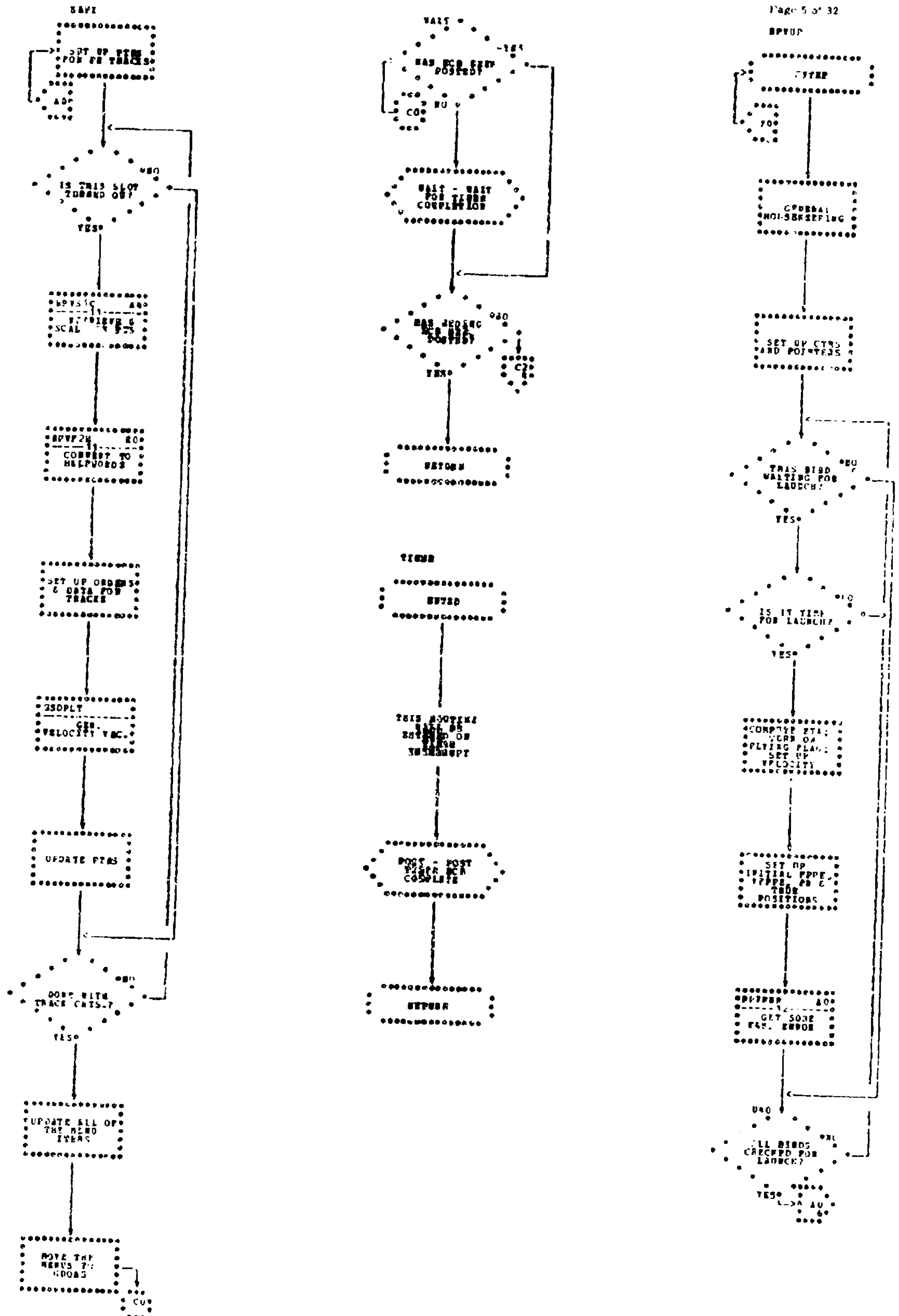


FIGURE 11. PROGRAM FLOWCHARTS (Continued)

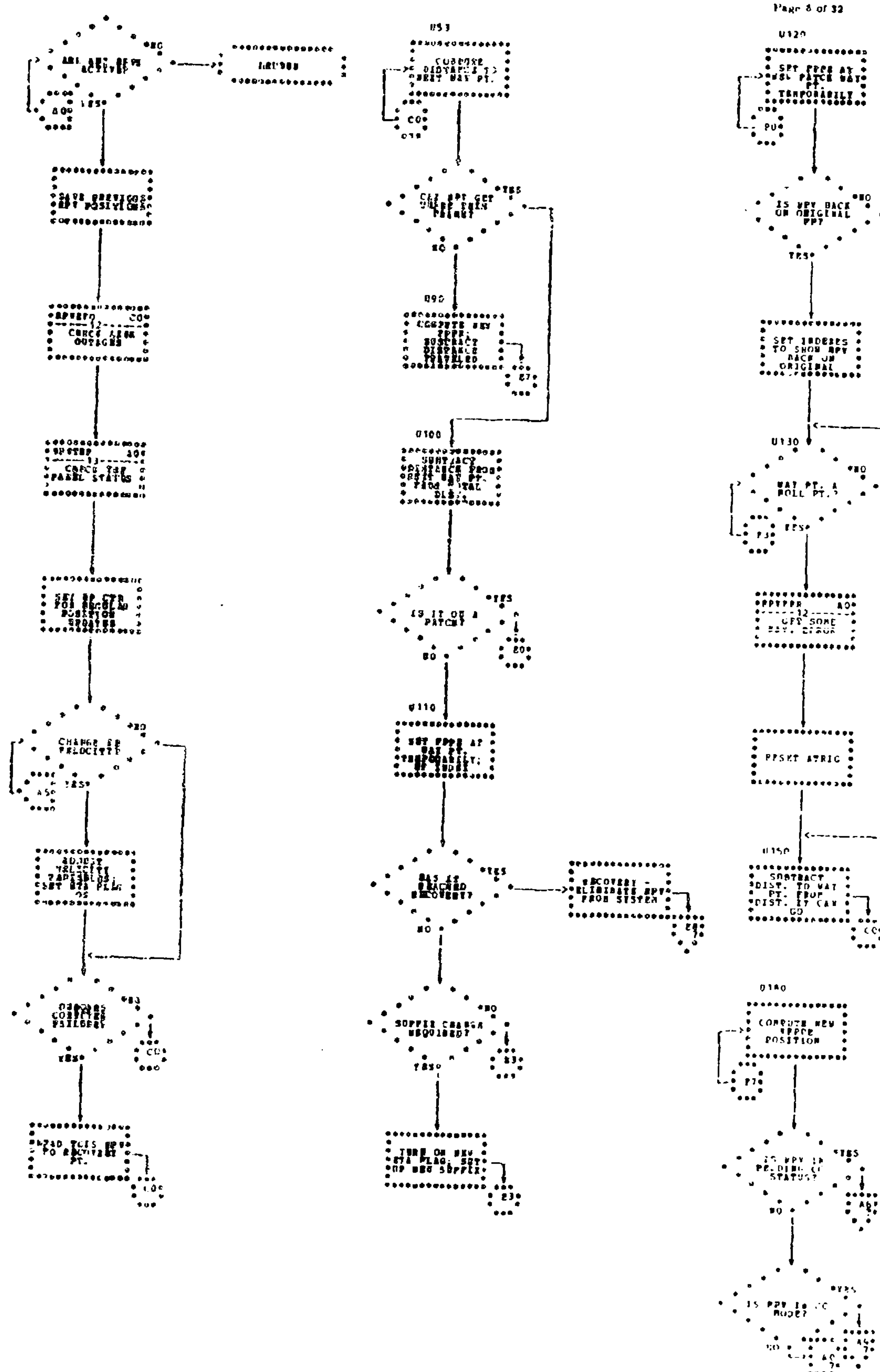


FIGURE 11. PROGRAM FLOWCHARTS (Continued)

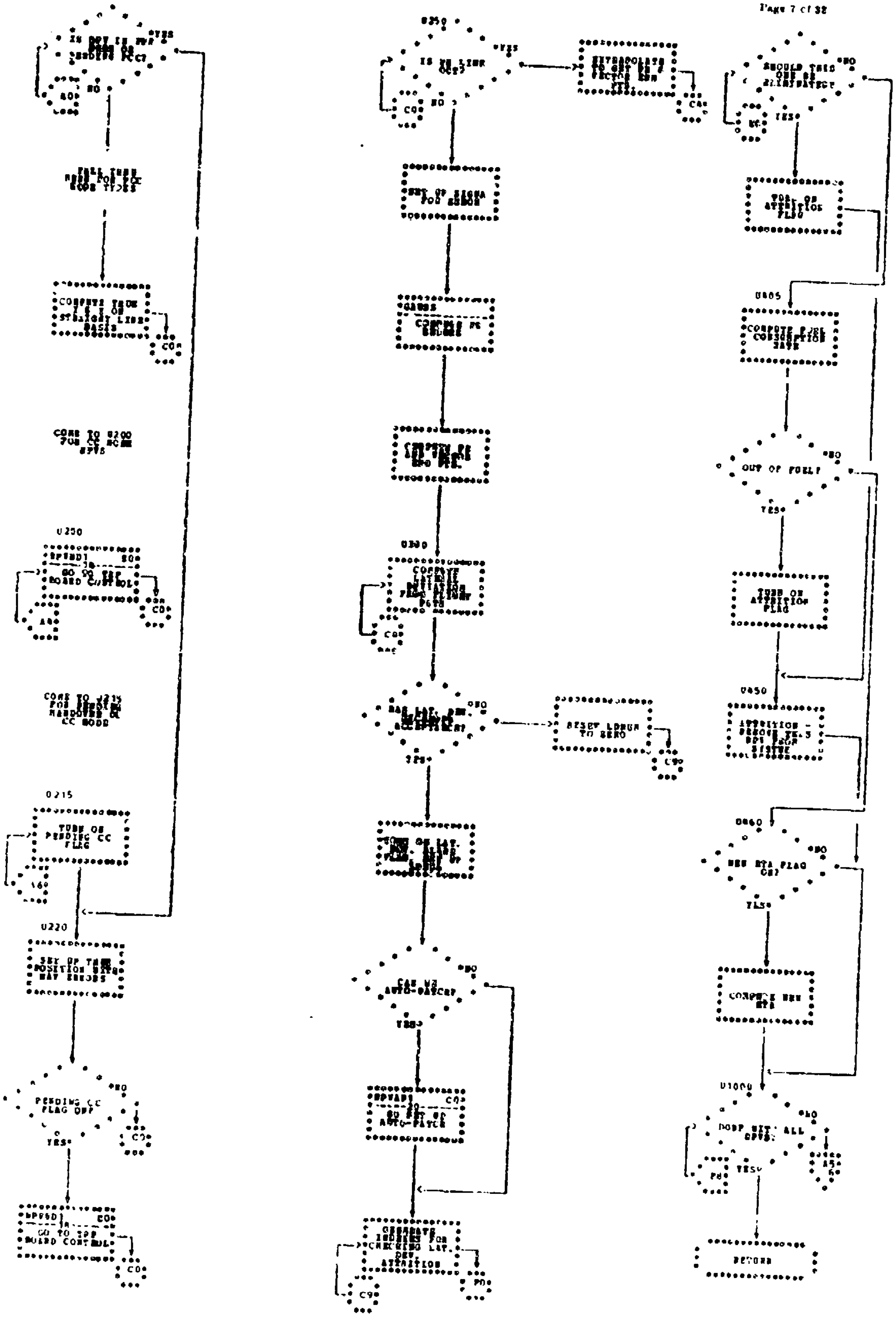


FIGURE 11 PROGRAM FLOWCHARTS (Continued)

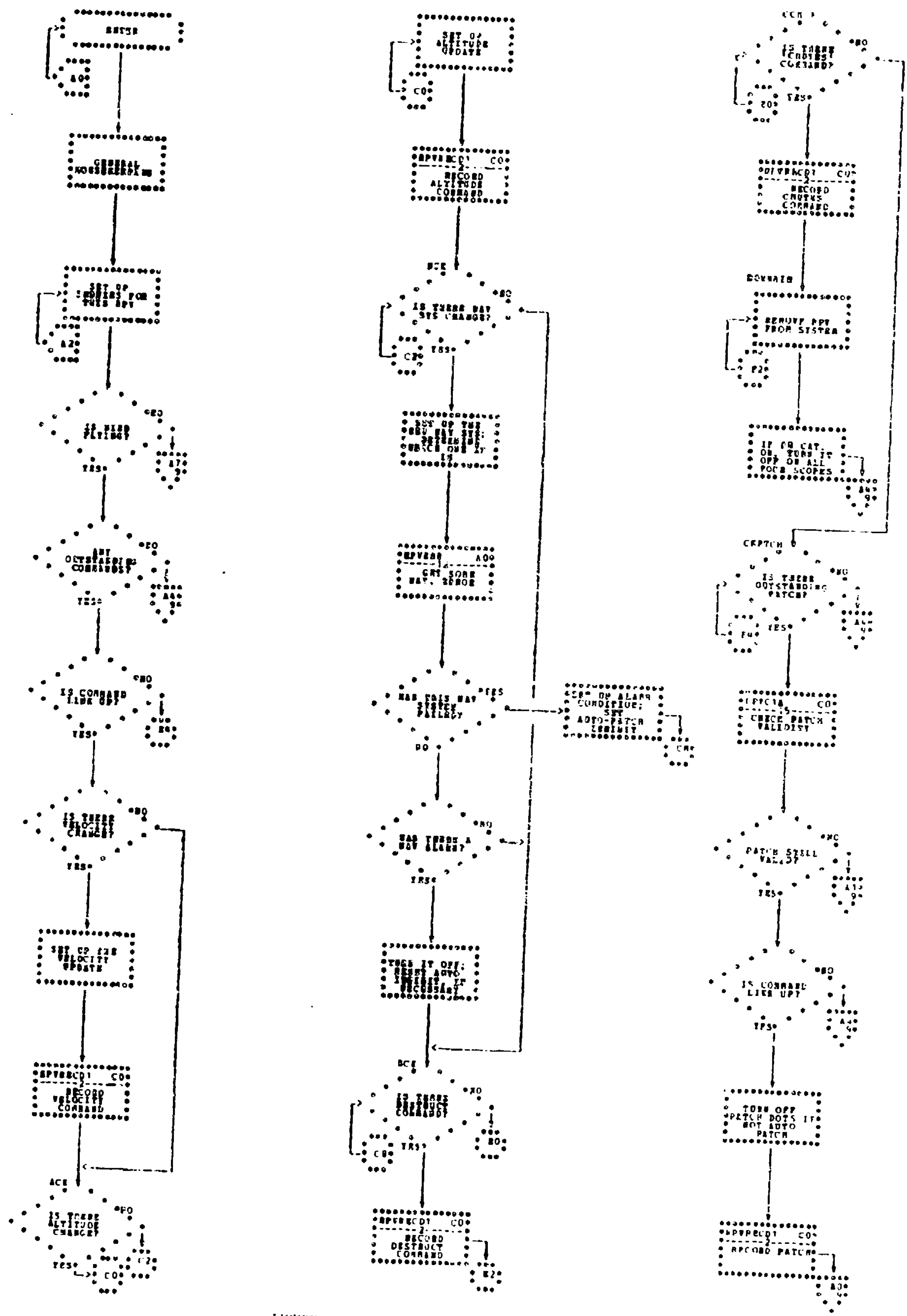


FIGURE 11. PROGRAM FLOWCHARTS (Continued)

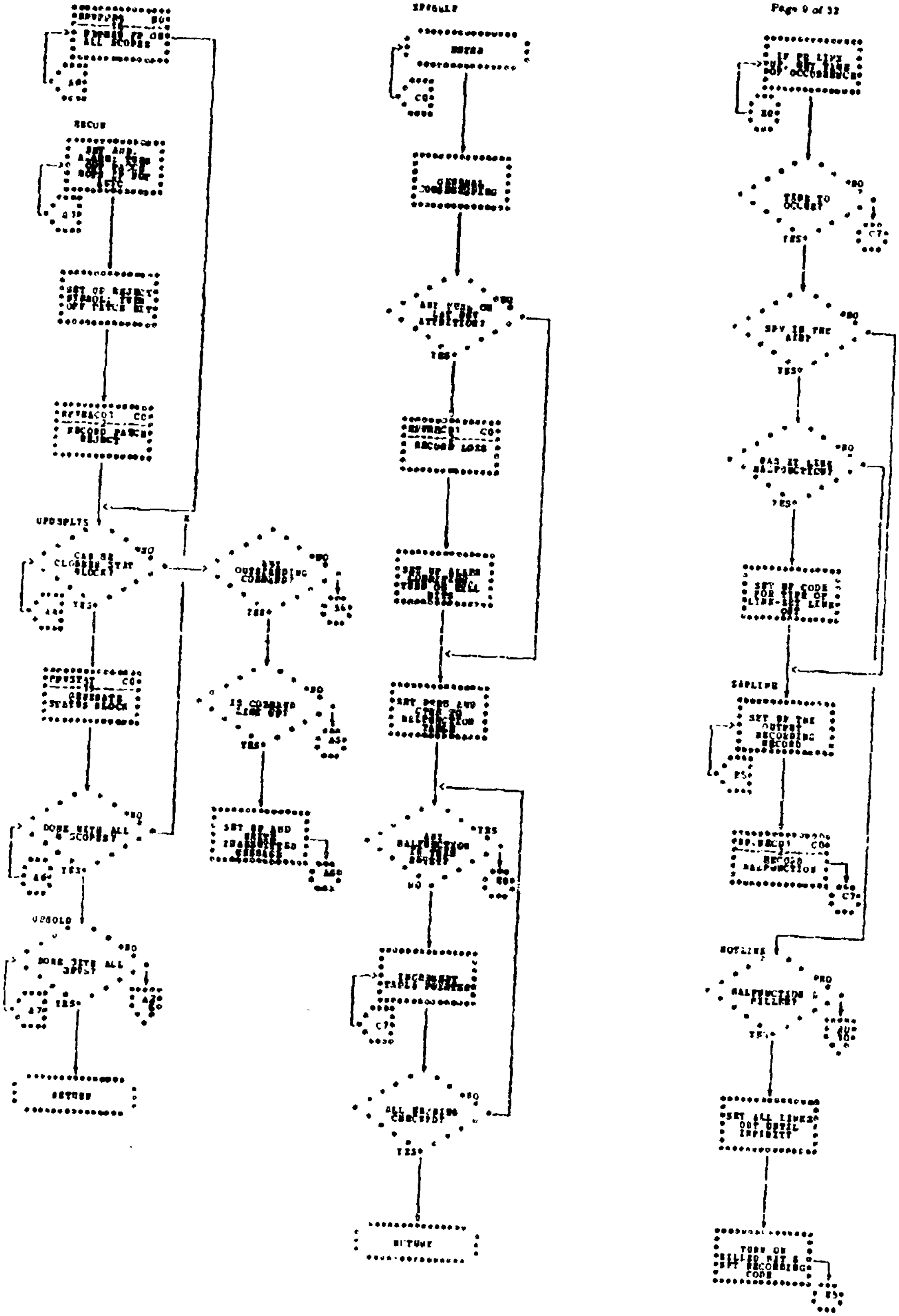


FIGURE 11. PROGRAM FLOWCHARTS (Continued)

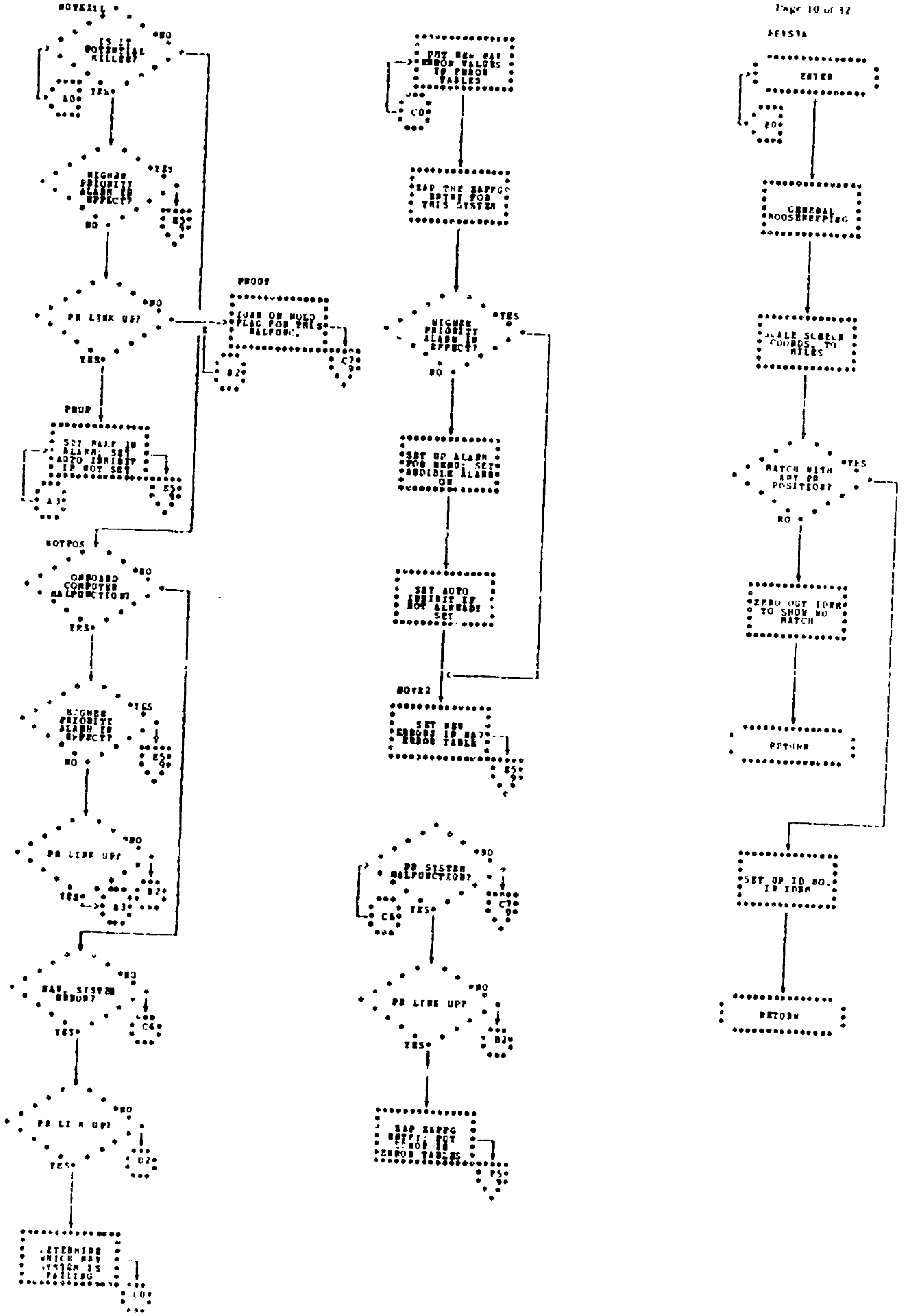


FIGURE 21. PROGRAM FLOWCHARTS (Continued)

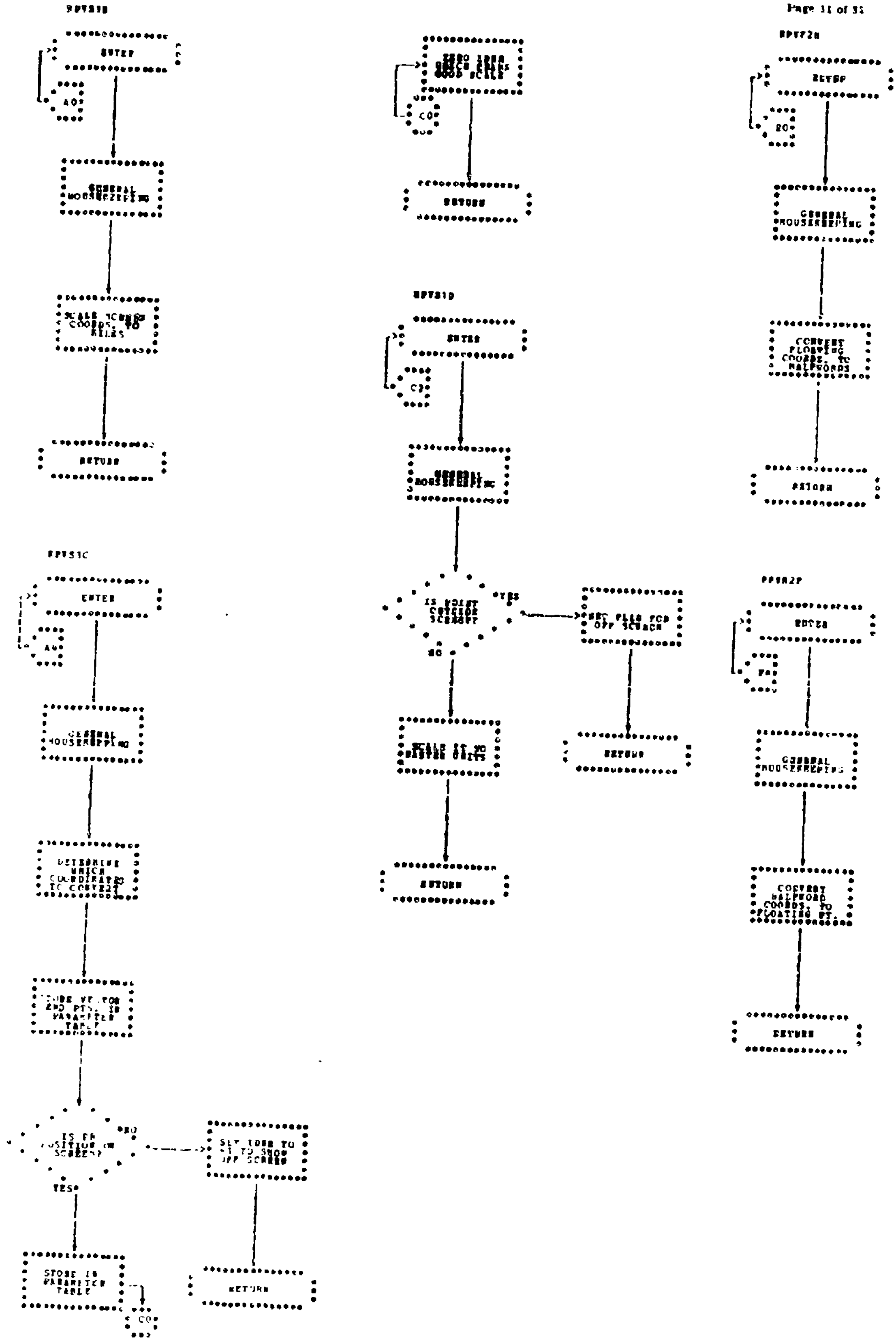


FIGURE 11 PROGRAM FLOWCHARTS (Continued)

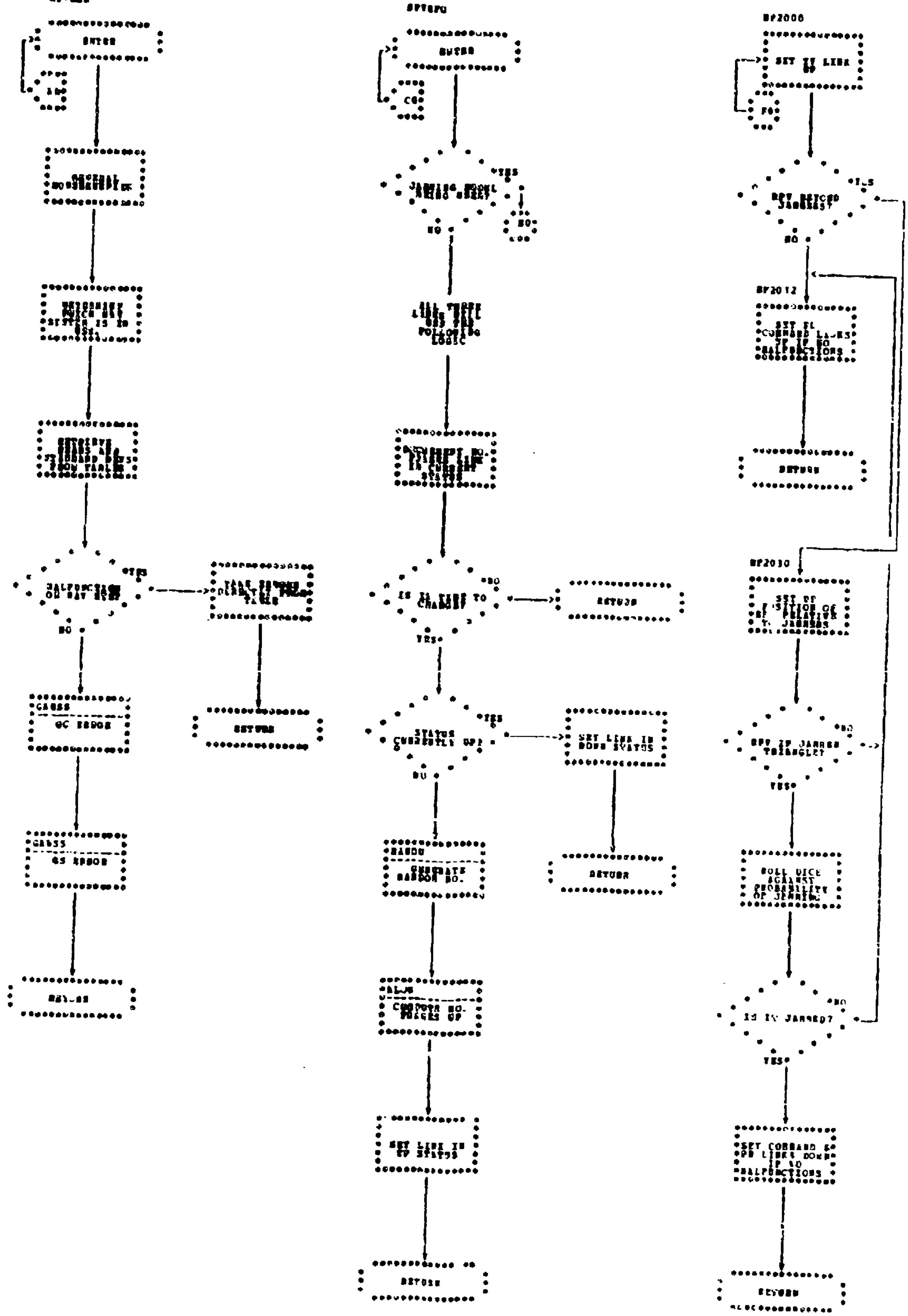


FIGURE 13. PROGRAM FLOWCHARTS (Continued)

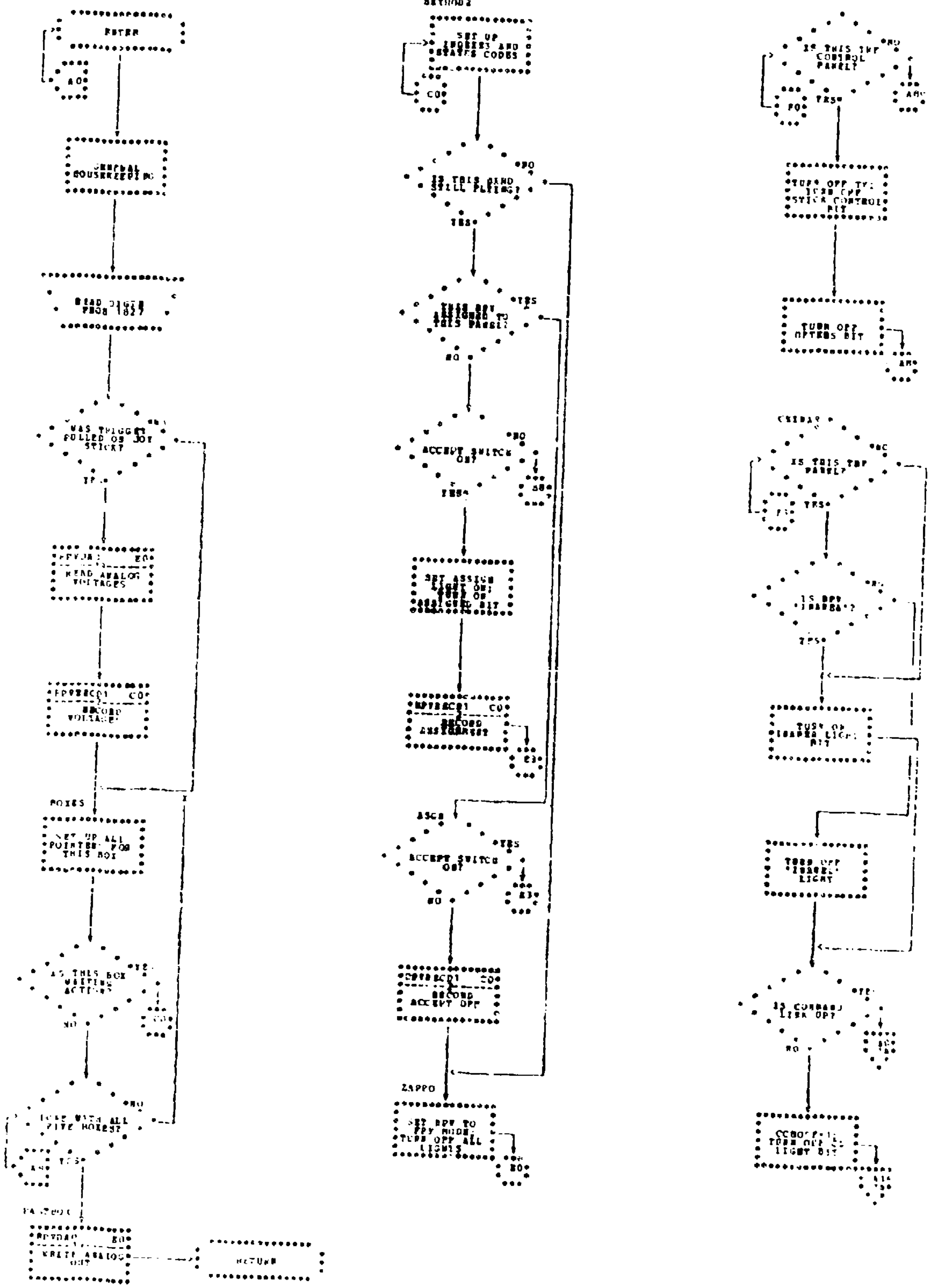


FIGURE 11 PROGRAM FLOWCHARTS (Continued)

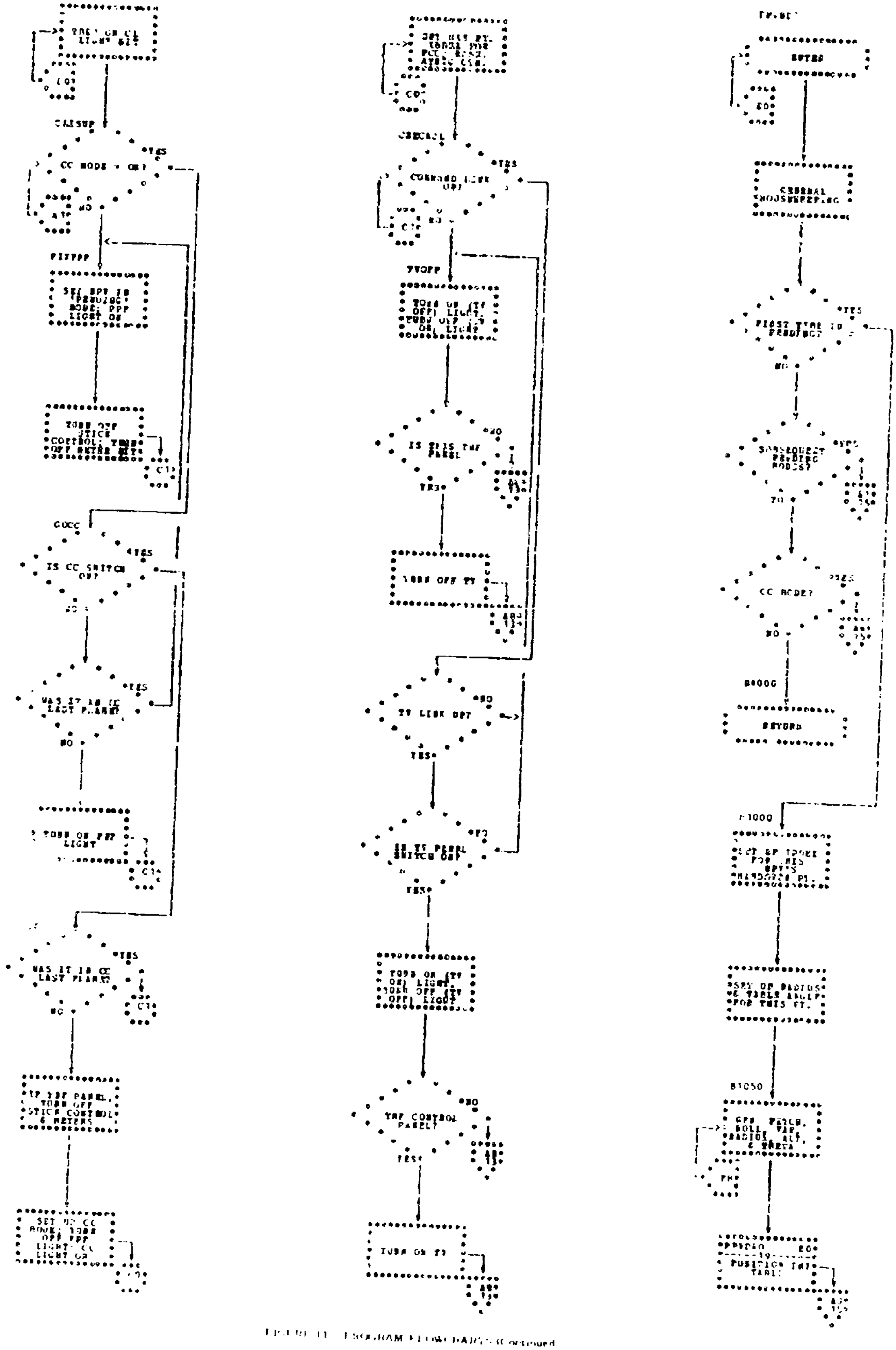
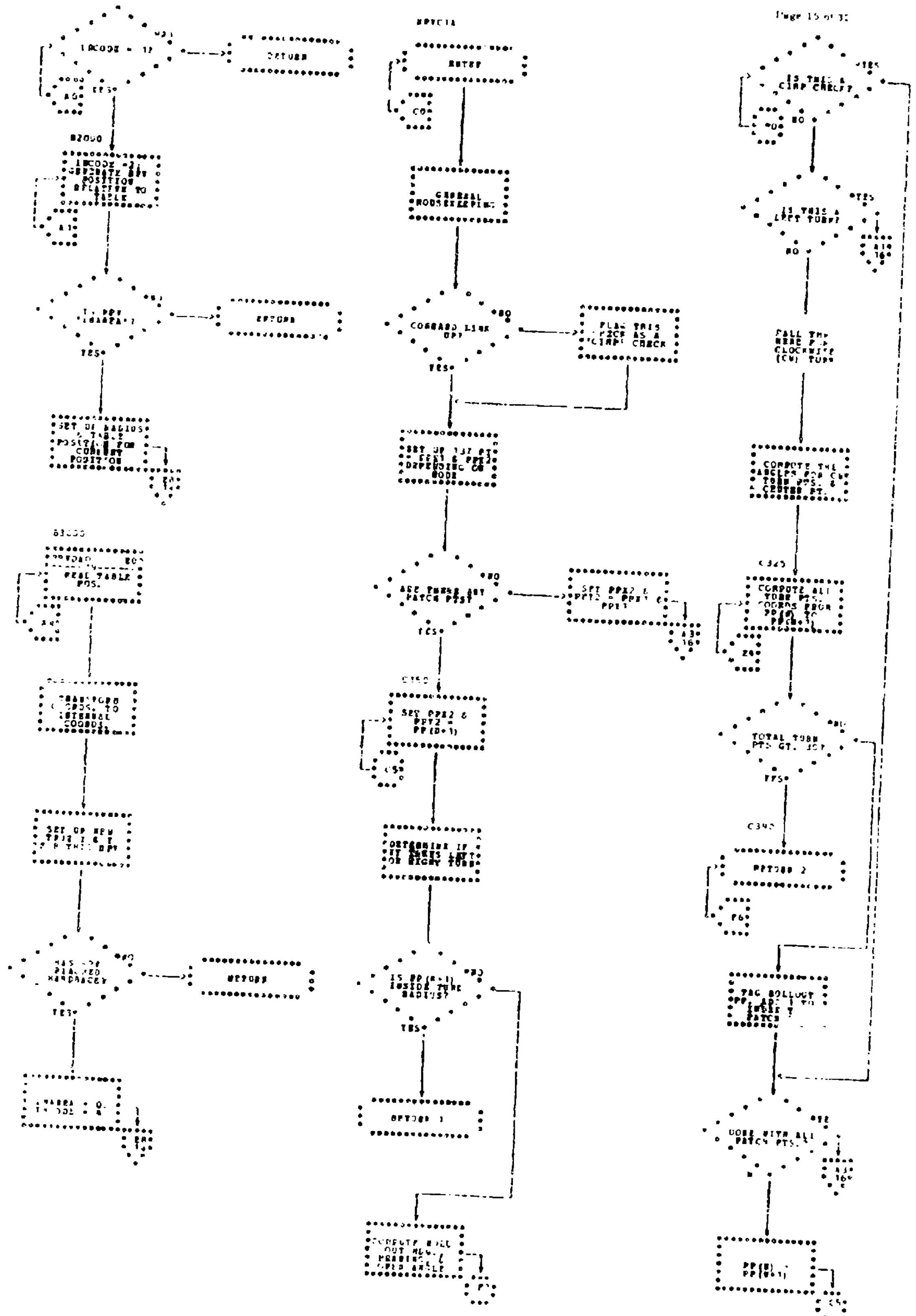


FIGURE 11. PROGRAM FLOWCHARTS (Continued)



PROGRAM FLOWCHARTS

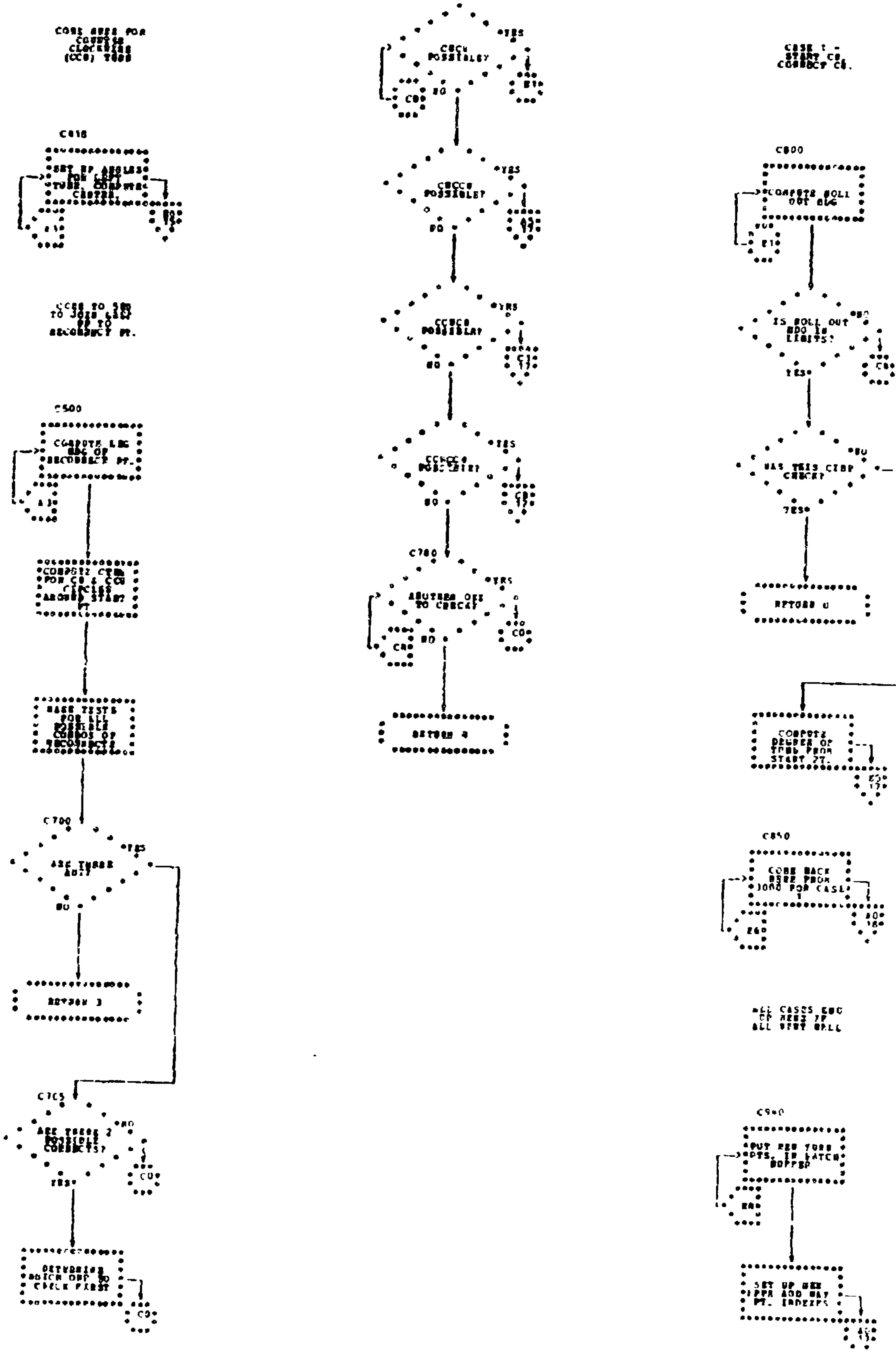


FIGURE 11. PROGRAM FLOWCHARTS (Continued)

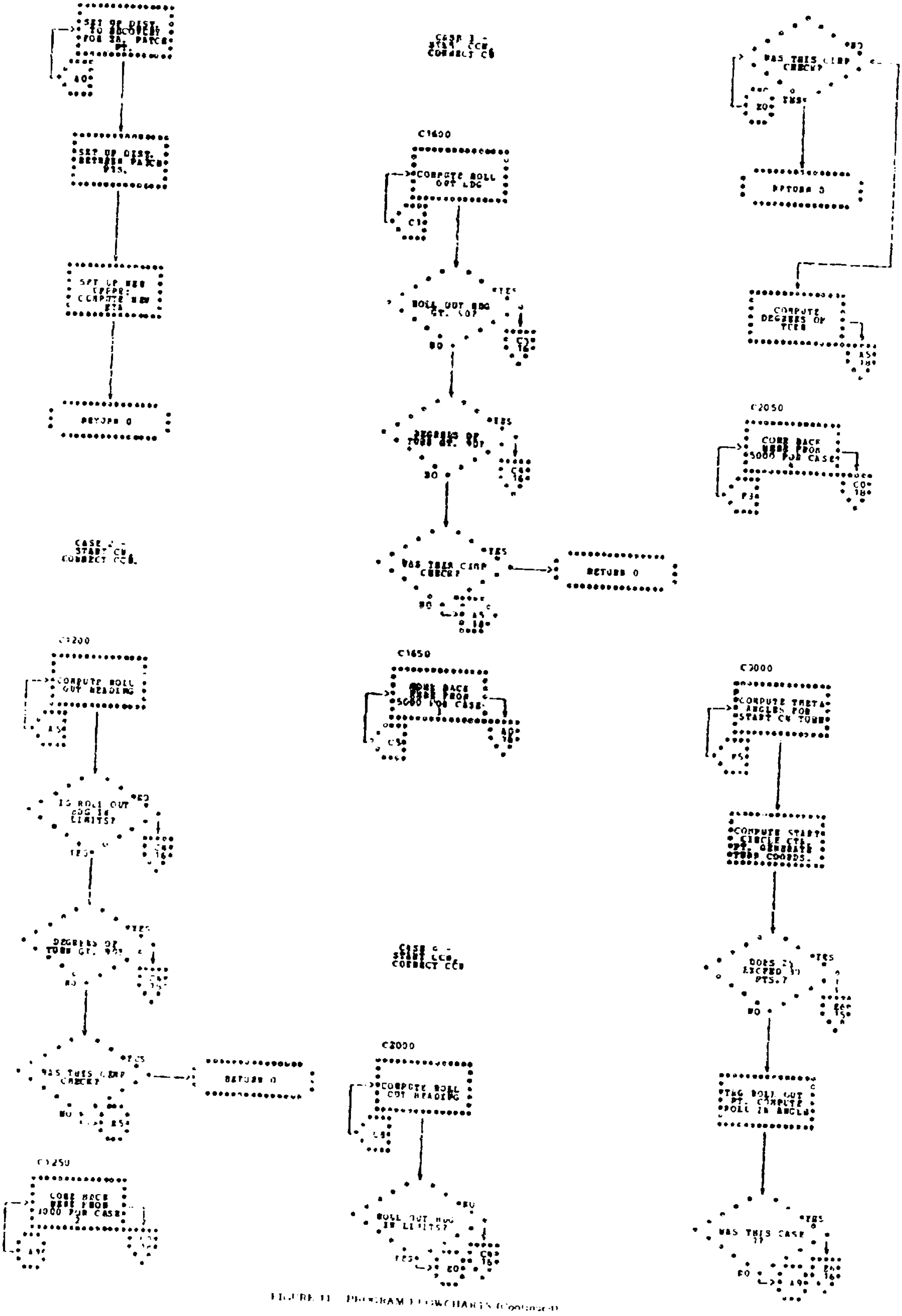


FIGURE 11 PROGRAM FLOWCHARTS (Continued)

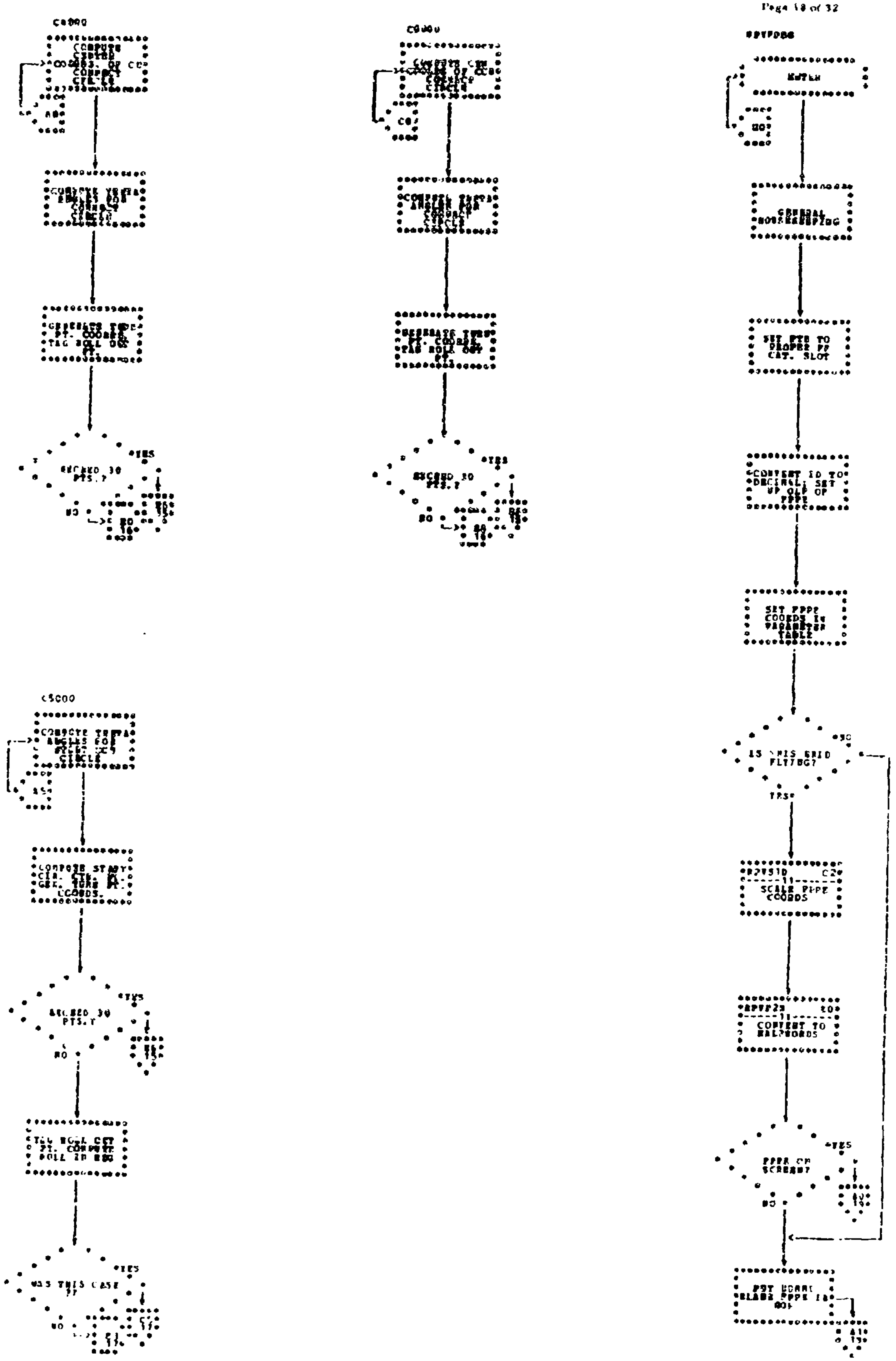


FIGURE 11. PROGRAM FLOWCHARTS (Continued)

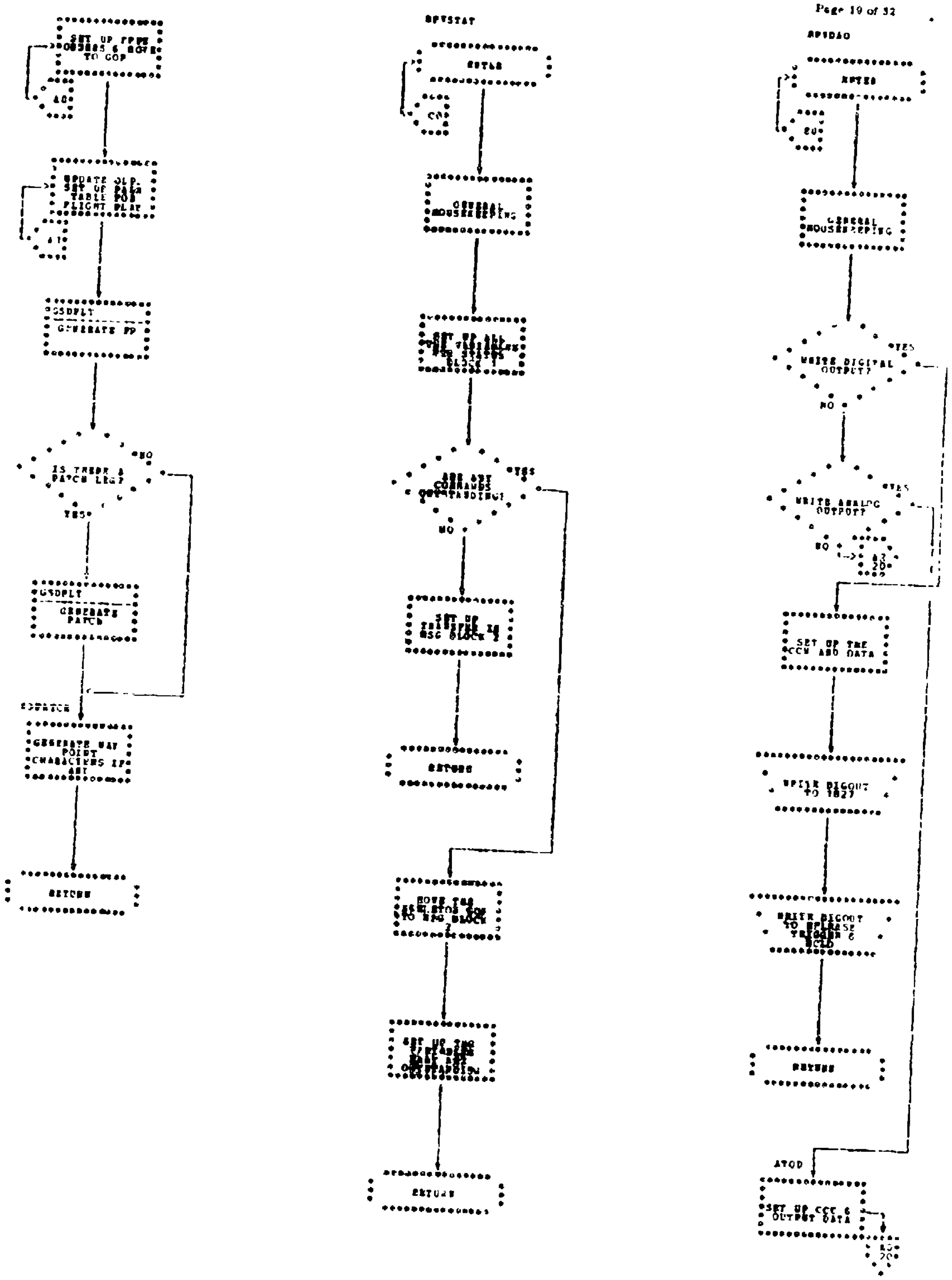


FIGURE 11. PROGRAM FLOWCHARTS (Continued)

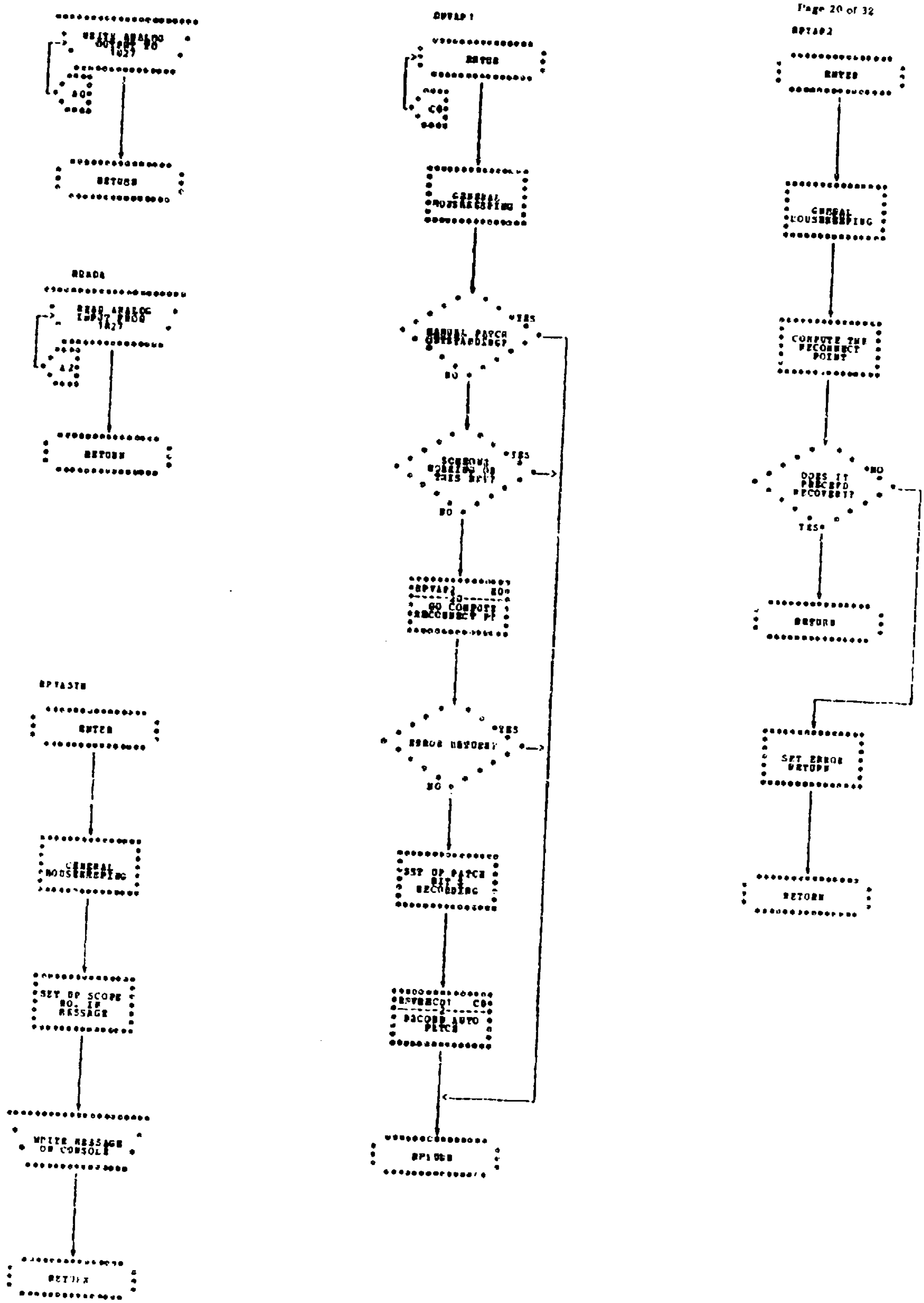


FIGURE 11. PROGRAM FLOWCHARTS (Continued)

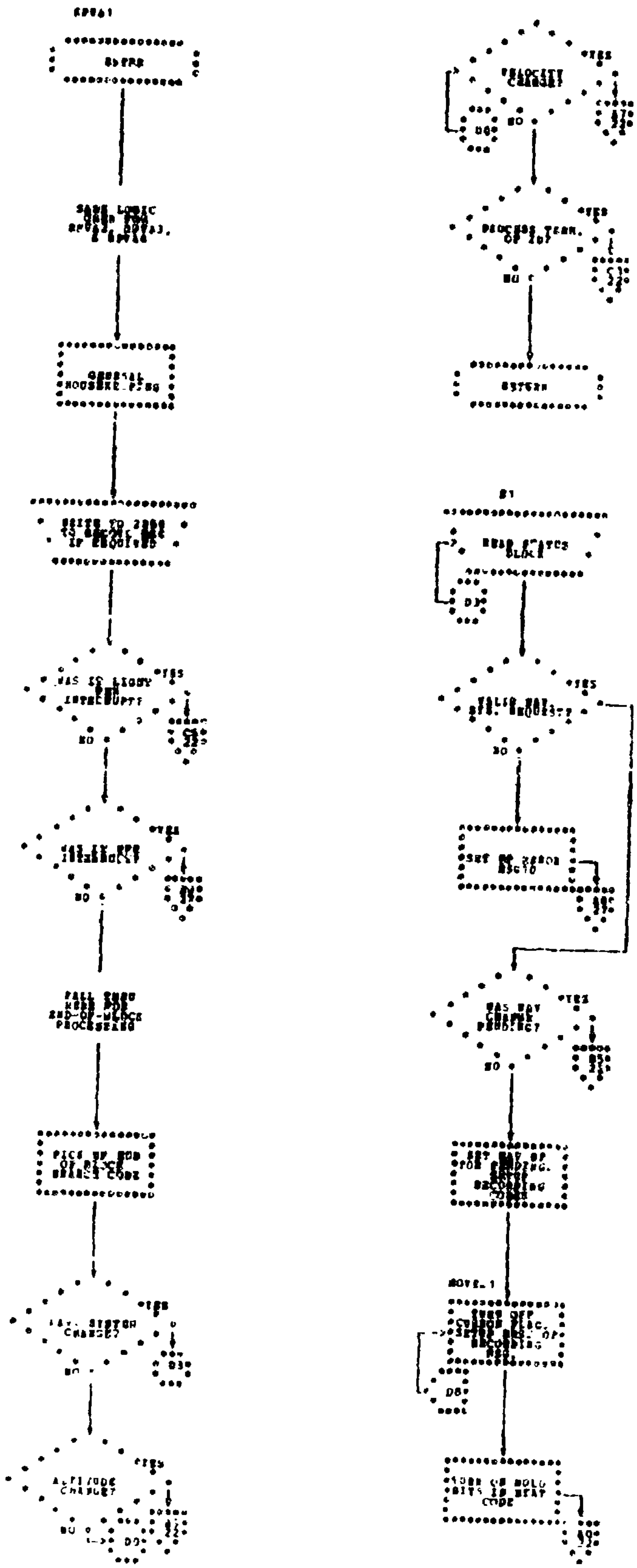


FIGURE 11. PROGRAM FLOWCHARTS (Continued)

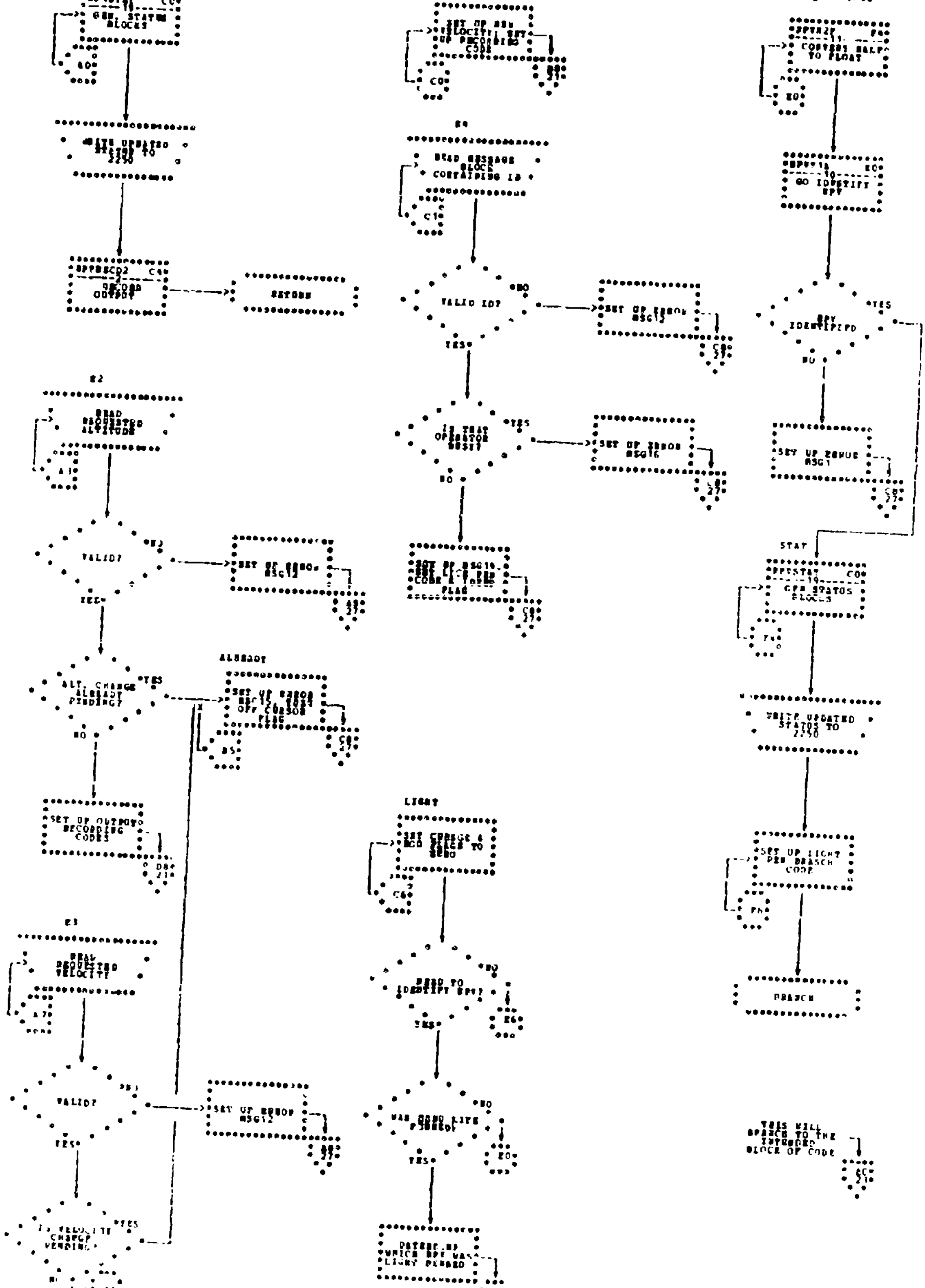


FIGURE 11 PROGRAM FLOWCHARTS (Continued)

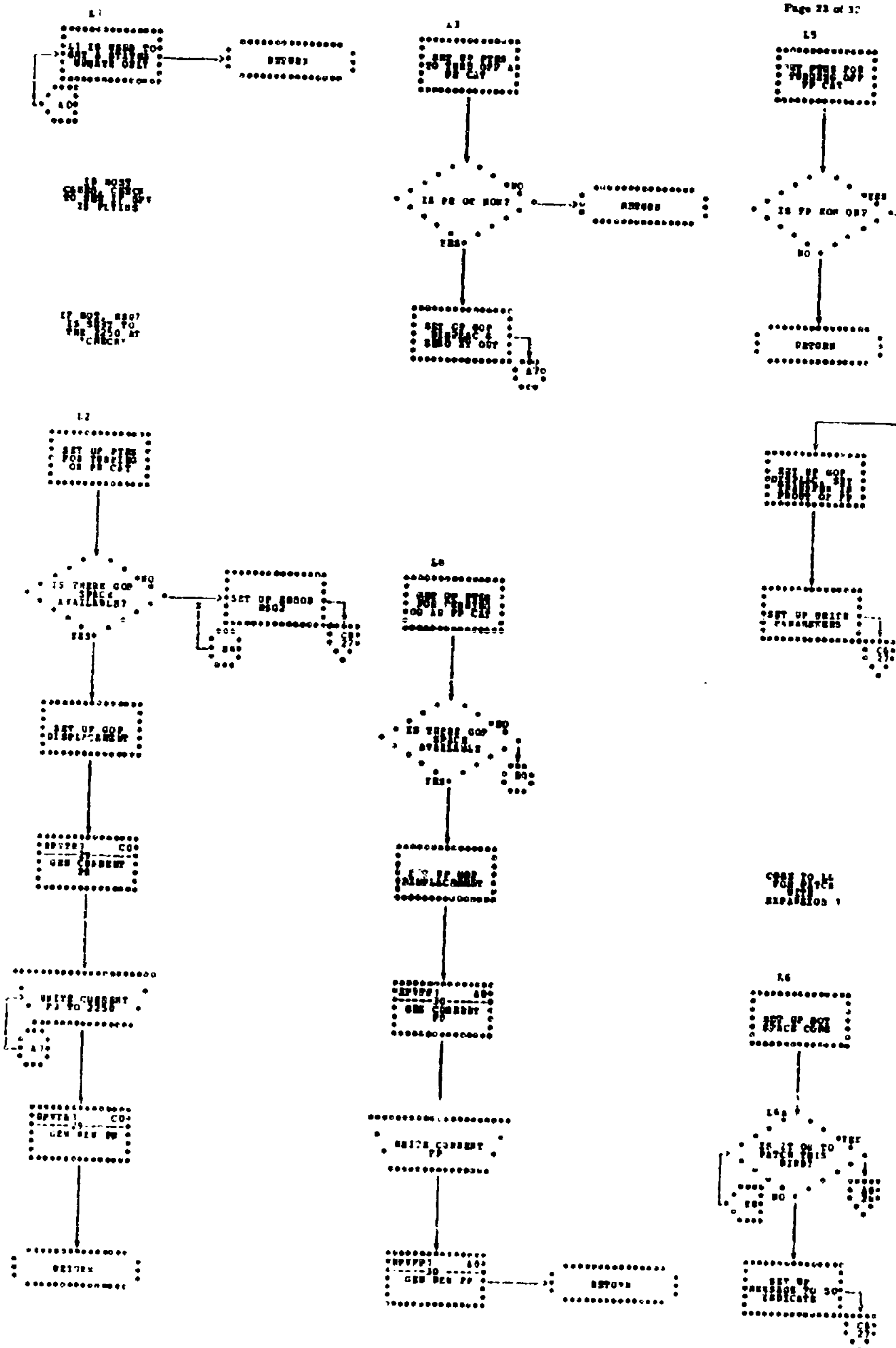


FIGURE 11 PROGRAM FLOWCHARTS (Continued)

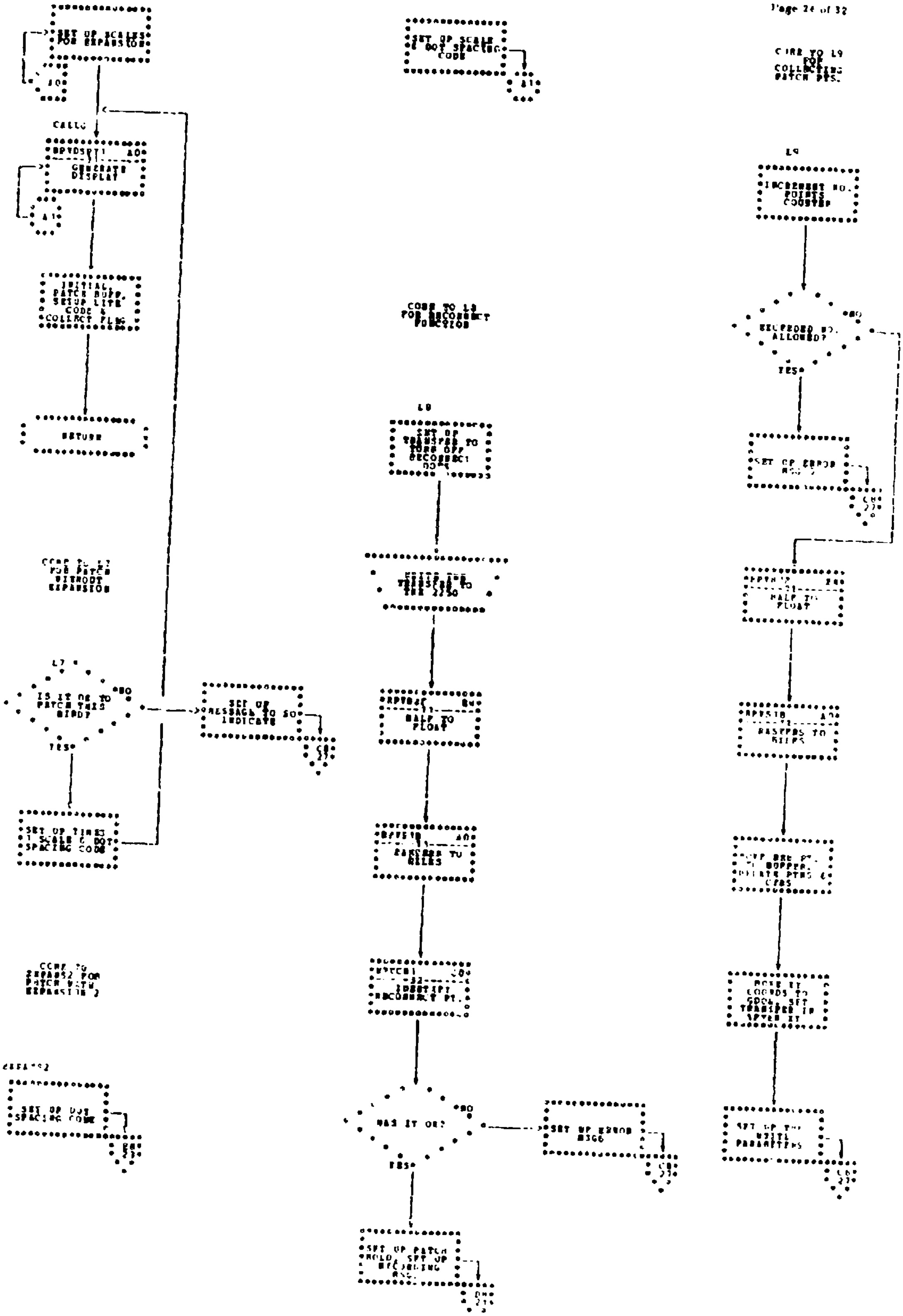


FIGURE 11 PROGRAM FLOW-CHARTS (Continued)

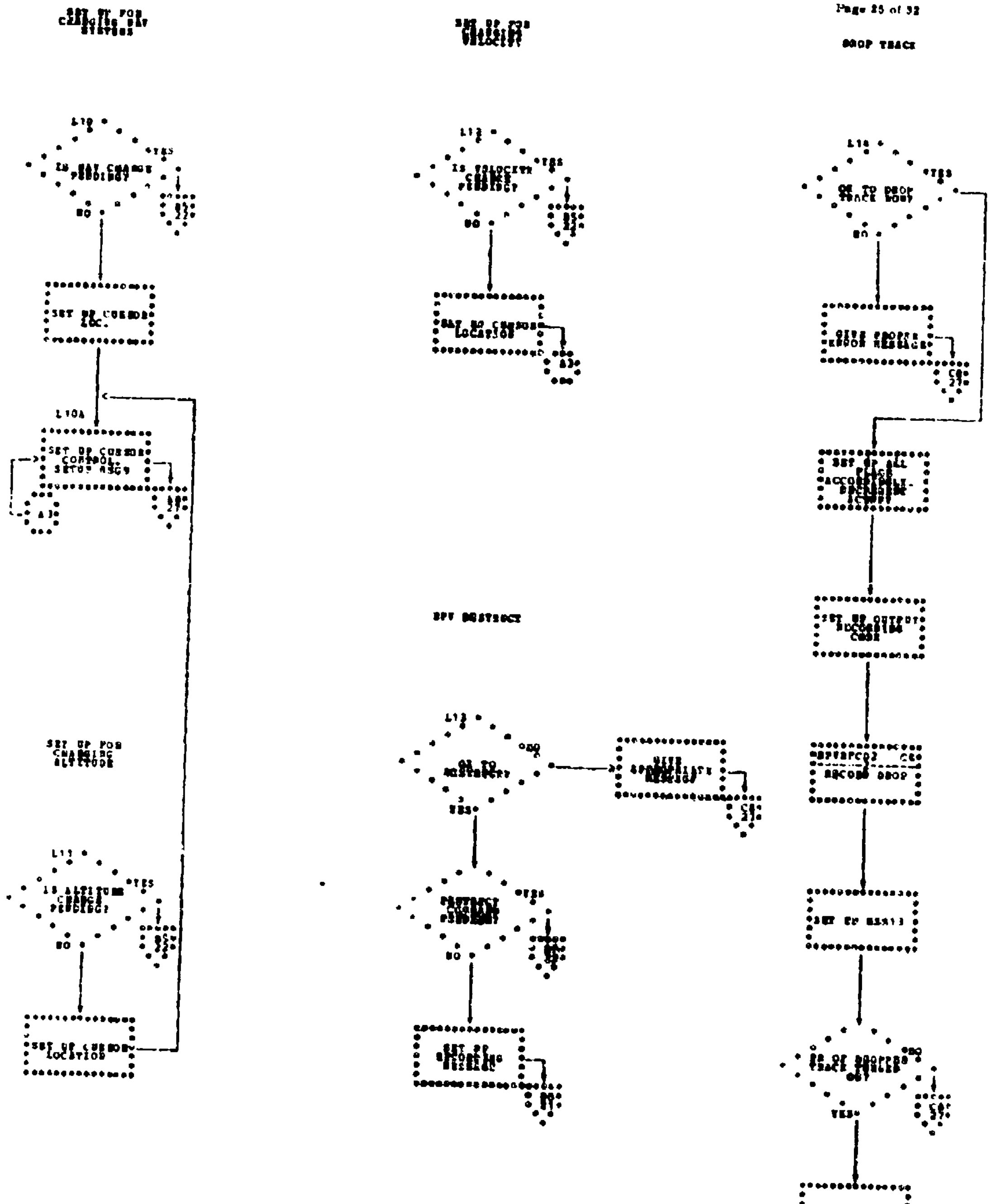


FIGURE ... PROGRAM FLOWCHARTS (Continued)

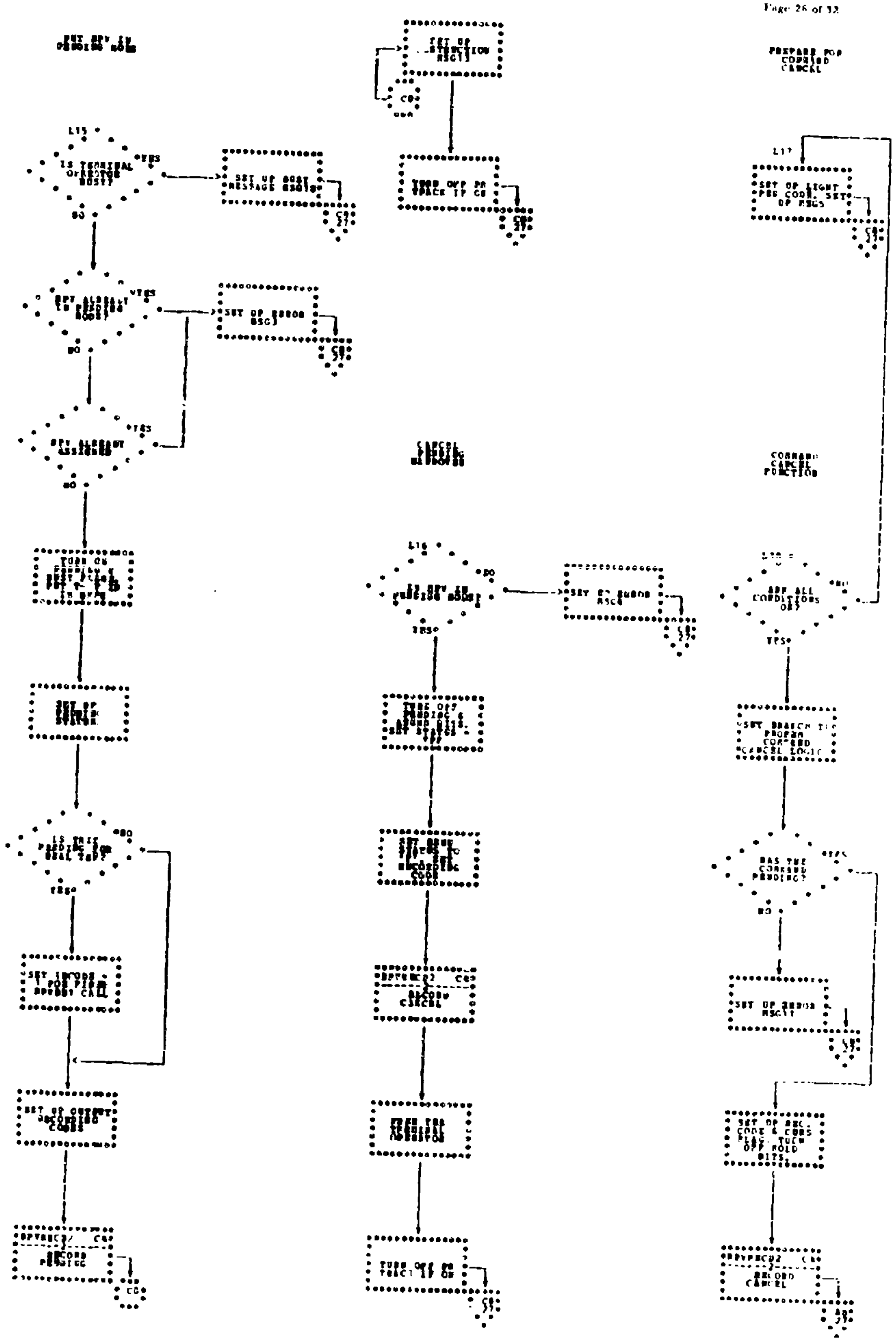


FIGURE 11 PROGRAM FLOWCHARTS (Continued)

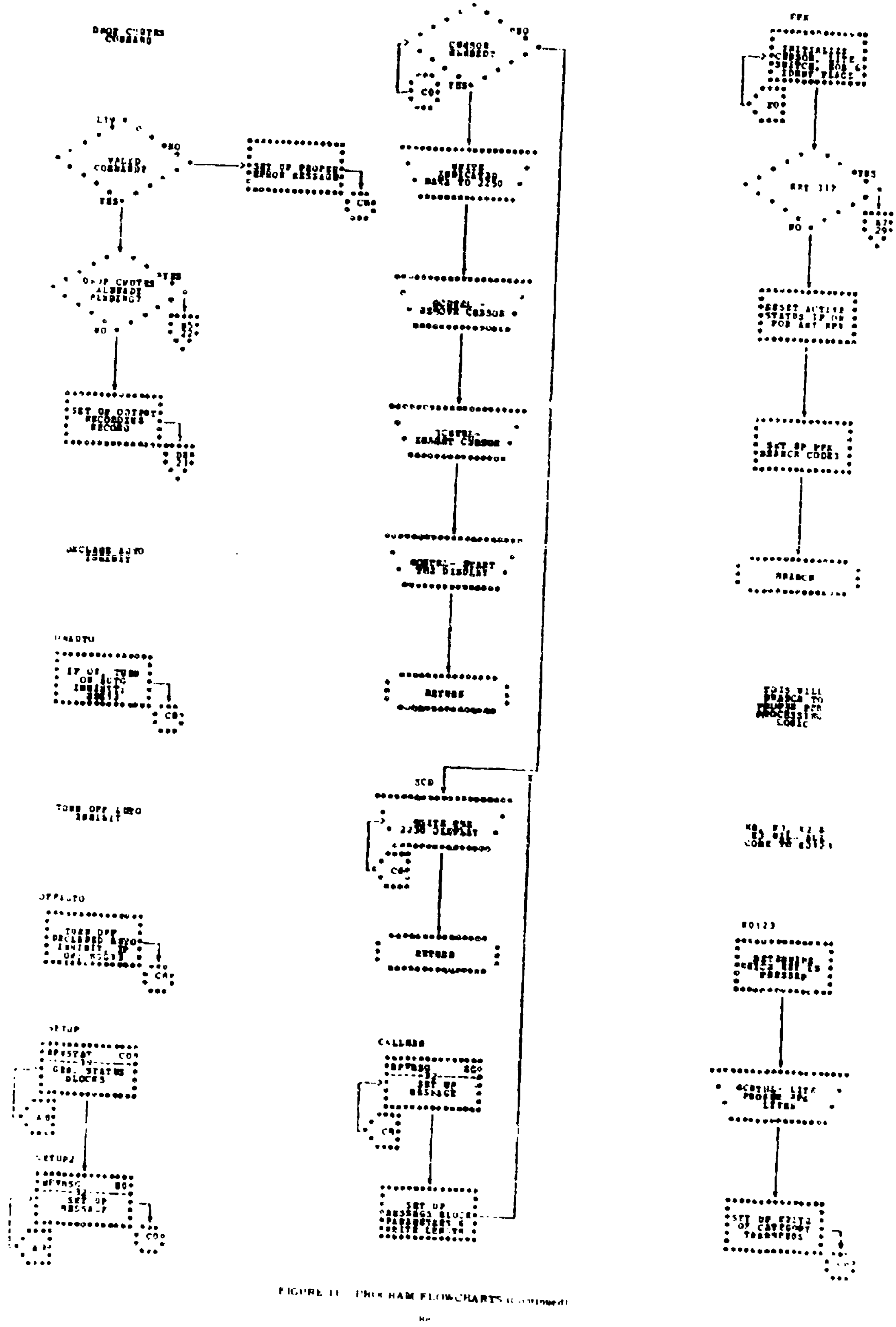
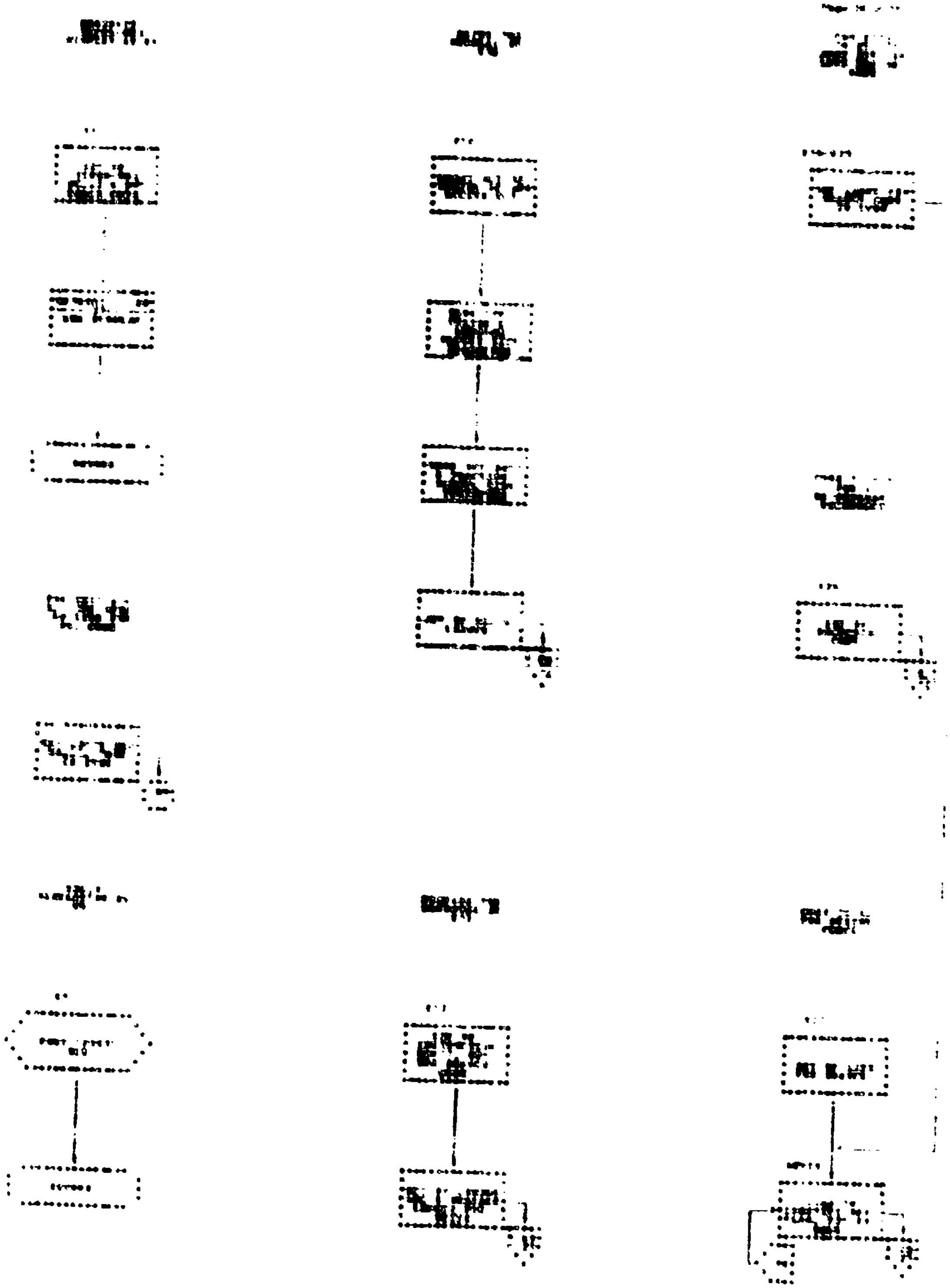
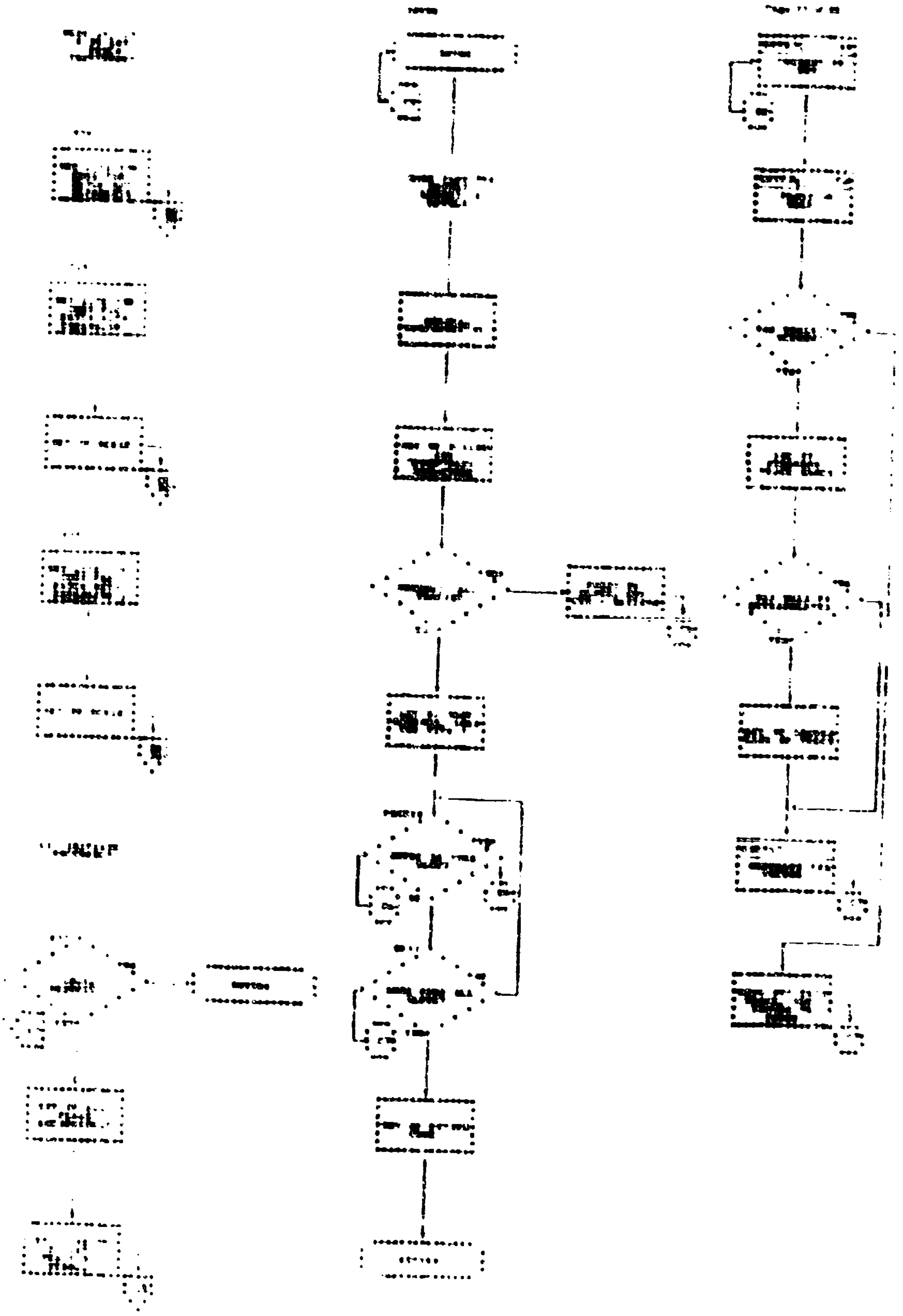
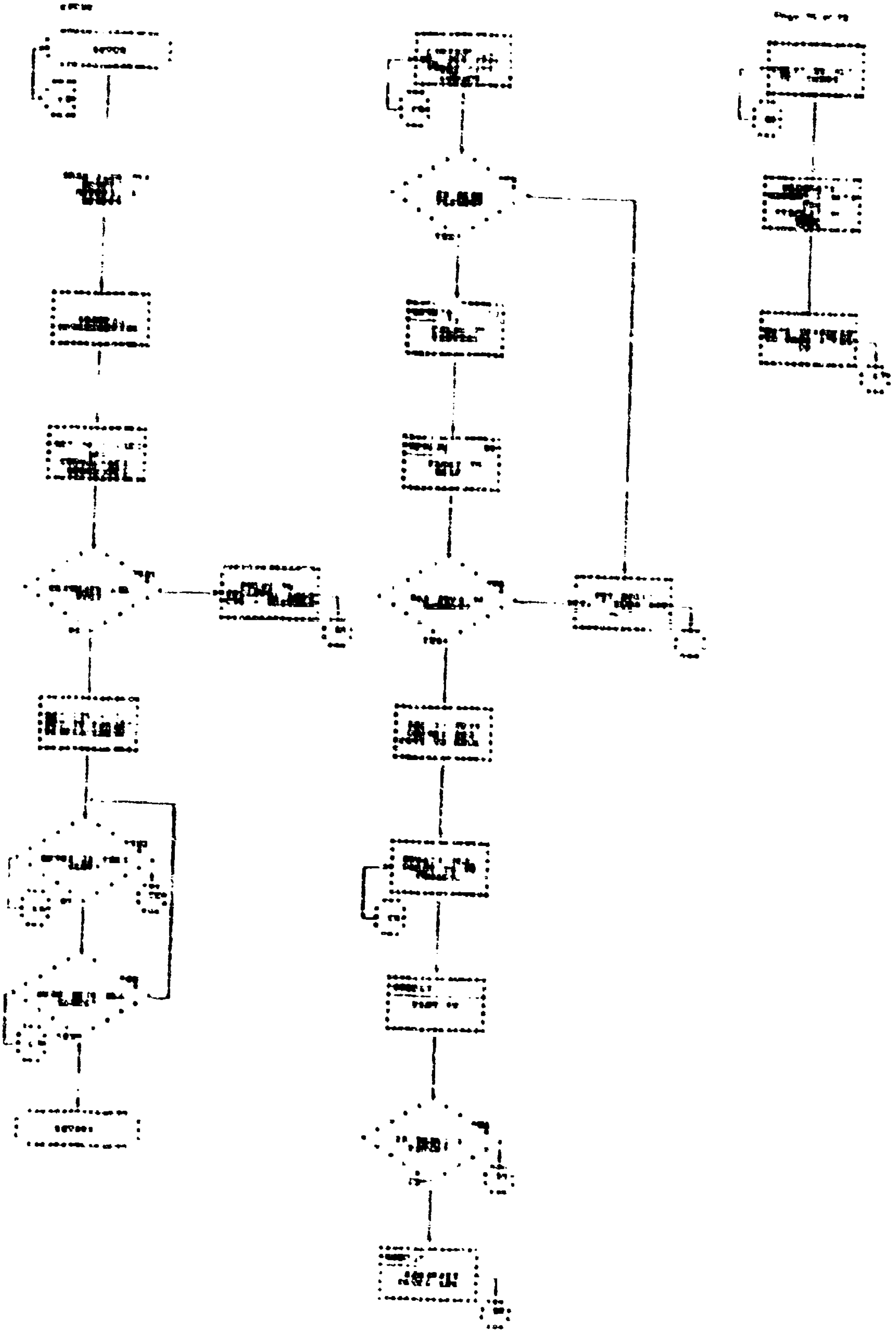
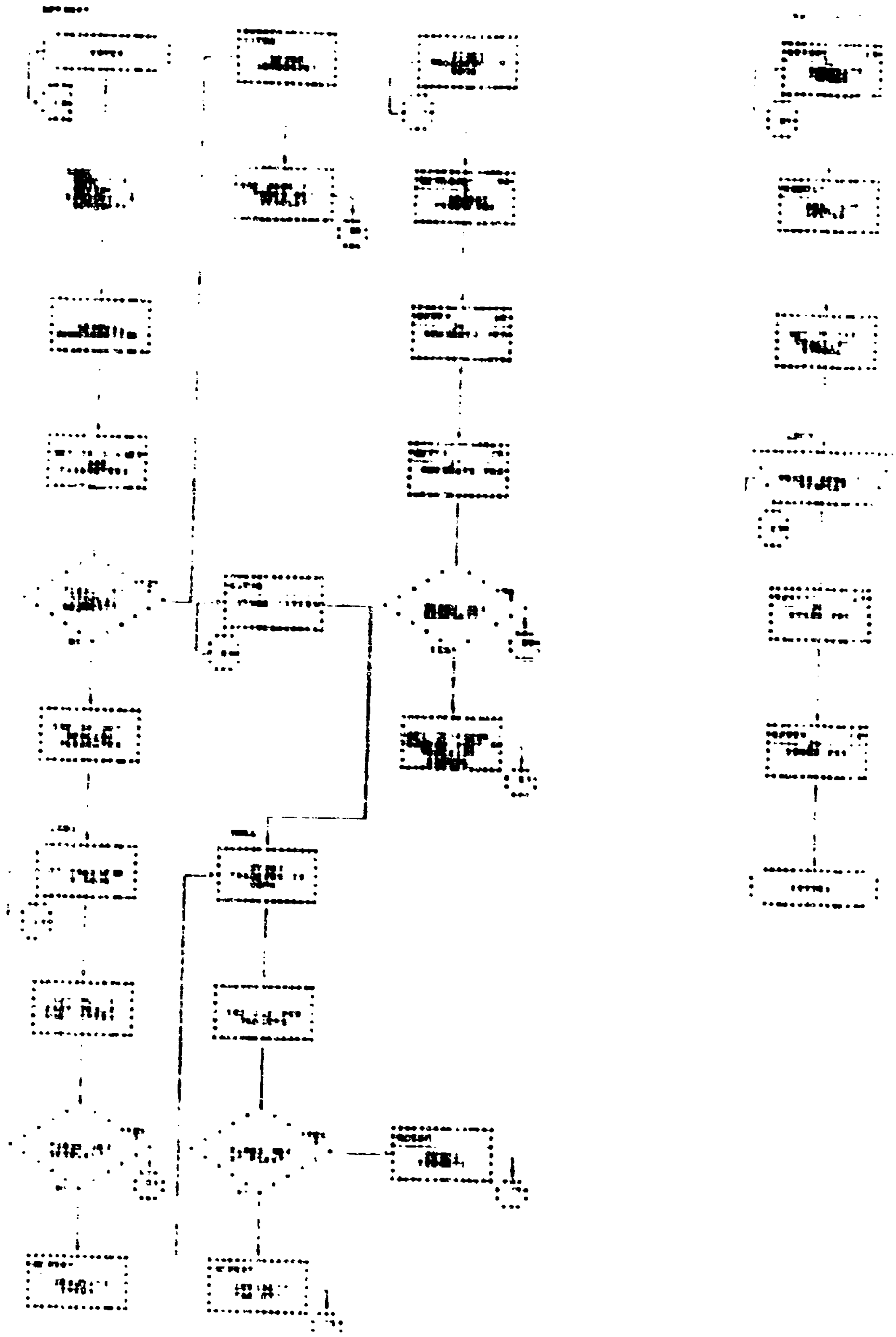


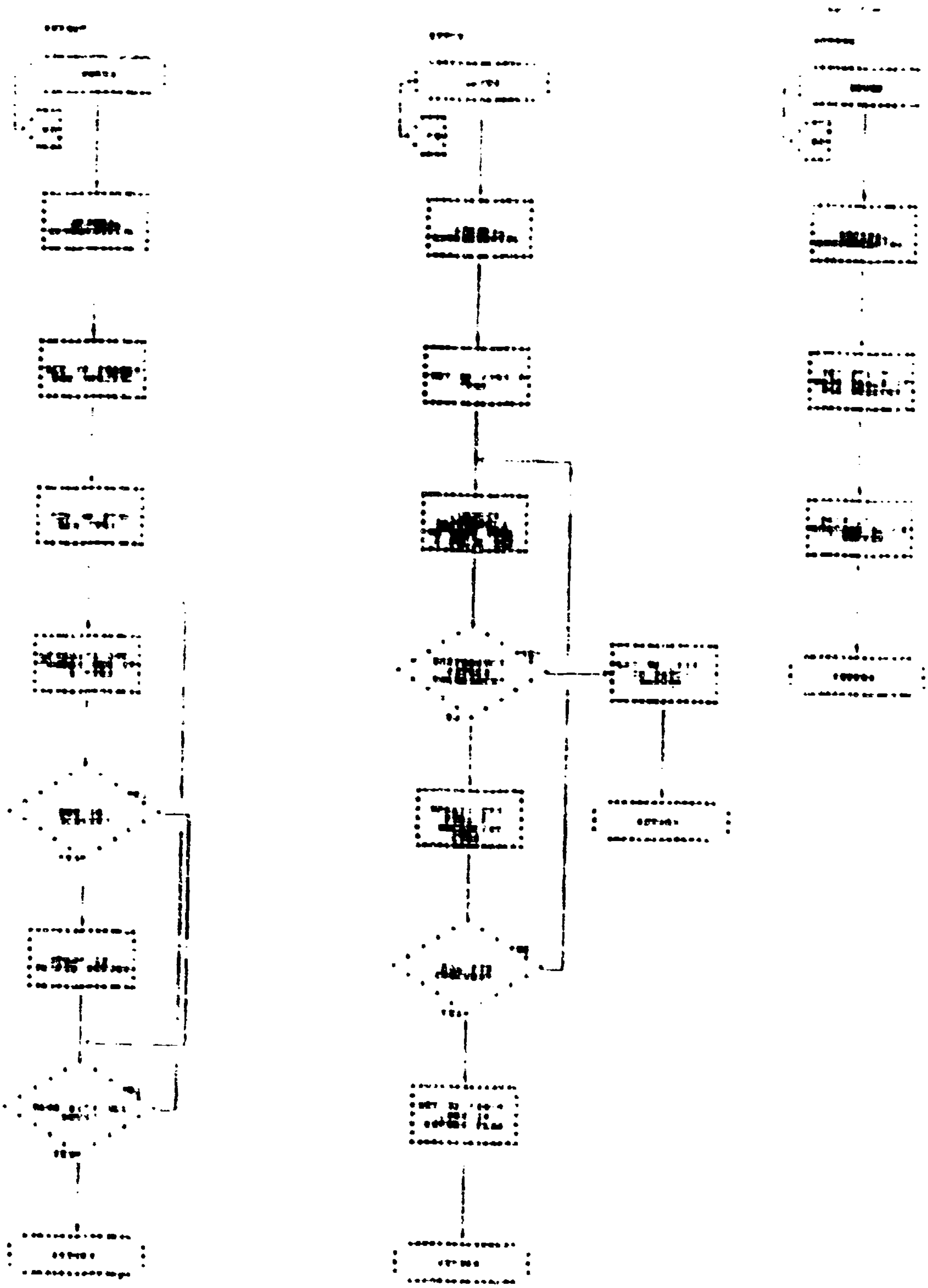
FIGURE 11 PROGRAM FLOWCHARTS (Continued)











APPENDIX I

COMPUTER OPERATOR INSTRUCTIONS

The following steps should be taken by the computer operator executing the RPV-AUTO Simulation Program.

1. Place the "RPV Patch Board" in the 1827 DCU Patch Panel.

2. Make sure all equipment is turned on at the remote terrain table site.

3. Turn on all necessary equipment at the HESS facility including the Terminal Operator Control station.

4. Load the execution deck in the card reader and ready it.

5. Mount the requested disk packs.

6. Copy the ID number off the log sheet and give it to the experimenter.

7. Remove card decks and printed listing at the end of the run.

APPENDIX II

EXPERIMENTER INSTRUCTIONS

The following steps may be used as a guide for the experimenter conducting the RPV-AUTO Simulation experiment.

1. Prepare the execution card decks as illustrated in Figure 10, Section VI. The data set names in the FT09F001 and OUT DD cards must be changed to the proper names and the data in the malfunction and calibration data sets, represented by the FT08F001 and FT05F001 DD cards must be from the most recent updates.

2. The PARM field on the execute card contains four characters representing the four scopes, units 2E0, 2E1, 2E2, 2E3 respectively. If the scope is on, punch a one in its respective position. If the scope is off or inoperative, punch a zero.

3. Place this deck in the card reader and press start.

4. Mount the specified disk volumes as indicated on the console typewriter. Steps 3 and 4 will be handled by a computer operator, if available.

5. An experiment ID number will be printed on the console typewriter. Record this number for later use.

6. Place PFK overlay sheets on PFK keyboards. See Figure 12.

7. The subjects should be seated in team positions, as desired, and their names recorded with the unit address of the scope associated with each position. The ID number and name of the input data set used should be recorded along with this information.

8. When everyone is ready, press PFK key 9 on one of the scopes to begin the experiment.

9. The program will automatically terminate when all the RPVs have reached their recovery points. Remove the card deck from the reader and the listing from the printer.

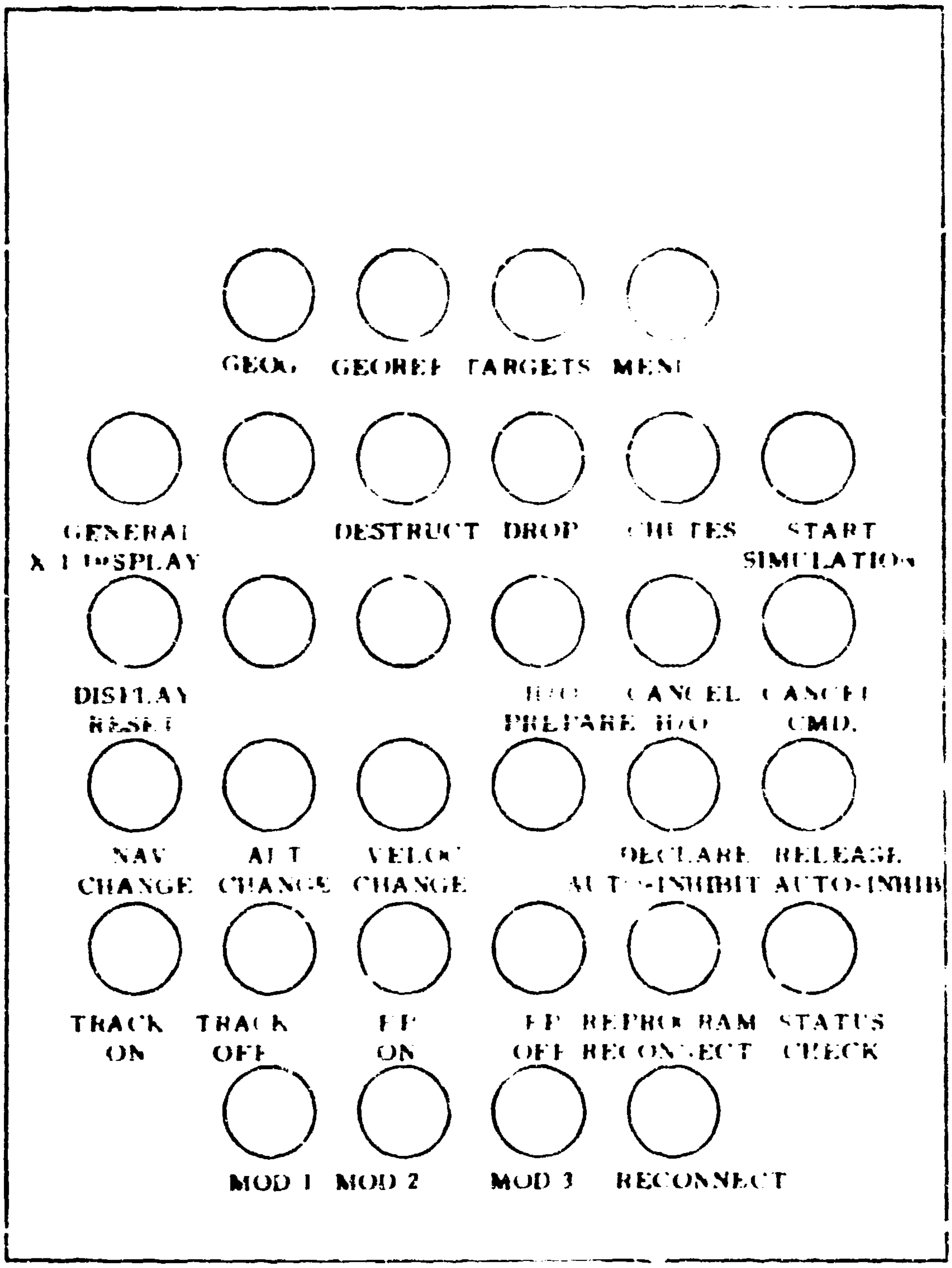


FIGURE 12. PEK OVERLAY CARD